

PROCEEDINGS
OF THE
CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVIII, No. 4, pp. 73-213, plates 8-23

MARCH 29, 1929

IV

**MARINE MIOCENE AND RELATED DEPOSITS
OF NORTH COLOMBIA**

BY
FRANK M. ANDERSON

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INTRODUCTION

The marine Eocene deposits of northern Colombia have already been described in earlier papers¹ and therefore require only general notice here. For the most part they occupy a broad synclinal area between the north coast of Colombia and the spurs of the northern Andes lying to the south. In the midst of this general syncline which extends for more than 160 miles, there are pronounced anticlinal folds extending parallel with its axis and also with the coast.

On the southern border of this syncline the Eocene rocks outcrop in an irregular zone following the contours of the pre-existing ranges and spurs, while upon its northern limb they outcrop in disconnected areas along the Caribbean coast from the west flank of the Sierra Nevada de Santa Marta to the Gulf of Urabá. A large area of these rocks, for example, lies west of the Rio Magdalena, extending north from Arjona nearly to the sea, and to the southwest for an unknown distance. The "Arjona group" mentioned in a former paper² occupies this area. Farther to the southwest other areas of Eocene are found in the Coloso range, in the Cerro de Cispata near Lorica, in the Cerros de las Palomas, and in other districts about the head of the Rio Sinú.

Wherever they are found the Eocene rocks are highly folded and are traversed by faults. In some cases they are much compressed and distorted, but they are sufficiently fossil bearing for identification.

POST-EOCENE SEQUENCE

The Eocene deposits of Colombia are for the most part, especially in the central areas of the syncline, overlaid by a sequence of strata of great thickness. In some places these later beds overlap the borders of the trough and along its coastal side flank it for many miles. While the succeeding divisions of this sequence are largely the result of reconnaissance, and only qualitative study can be claimed for them, yet it is believed that the more important series are properly distinguished, and their position in the column is undoubtedly

¹Anderson, F. M., *Proc. Calif. Acad. Sci.*, Vol. 17, 1928, pp. 1-29.

²Anderson, F. M., *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 10, 1926, p. 387.

correct. The maximum thickness of the post-Eocene formations is as much as 8,000 feet, of which the major part is referred to the Miocene, and the remainder, some 3,000 feet, may be largely, if not wholly, Oligocene in age. There is as yet only an imperfectly defined boundary between the two, while in some localities there is evident unconformity, and this may later prove to be the general condition.

In the Carmen-Zambrano section, elsewhere described,³ between the proved Eocene and the fossiliferous Miocene above, there is a great body of clays, sandy shales and calcareous concretionary beds that were tentatively classed as Oligocene. Some of the shale in this interval appears to be equivalent to the "Bombo shales" of Beck,⁴ while some of the strata may be lowermost Miocene, as described later.

The lower and major part of this sequence, as it occurs here and at other points along the Colombian coast, has been given in this paper the name of "Poso series," from the fact that in the Sinú region, where it was first recognized, and at other points on the north coast, various wells had been drilled into it for petroleum. It is well known to contain many seepages of oil and gas, and other evidences of having commercial possibilities as a source of petroleum.

West of the area of the Arjona rocks referred to above, as to the east of Turbaco, a later series of considerable thickness outcrops over a wide zone, in contact with the Eocene on the east and fossil bearing Miocene on the north and west. This series is here highly folded into a succession of anticlines extending from the railroad northeasterly for some miles. The gas vents, mud volcanoes, or the "Turbacos" of von Humboldt, have their origin in this series of rocks.

Its stratigraphic position is between the Eocene and the Miocene, and will doubtless find a place in the Poso series as described later, though whether the complete series is represented here is not known.

In the column drawn by Elfred Beck (p. 463), the "Huertas series" 1,000 feet in thickness, is divided into two nearly equal parts by the semblance of an unconformity, though it is not mentioned as such.

³Anderson, F. M., *Proc. Calif. Acad. Sci.*, vol. 17, 1928, p. 11.

⁴Beck, Elfred, *Econ: Geol.*, vol. 16, 1921, pp. 463-465.

The upper portion of the "Huertas series," as shown by the fossils, and as observed by the present writer, is properly Miocene, belonging to a group which will be described later.

The lower portion immediately overlies the "Bombo shales," with which it appears to have stratigraphic continuity. The "Bombo shales" have been shown to be of Oligocene age, though this determination applies to not more than 500 feet of strata.

The Poso series. For the purpose of recording some observations made in the Tertiary districts of north Colombia in 1914-1915, and at later dates, and to call out further discussion of the subject, the following pages have been selected from personal notes, reports of assistants, and from various data obtained by the writer, covering the general region of the Rio Sinú and its environs, which describe in some detail the formations that, in the light of present evidence appear to intervene between the Eocene and the Miocene series.

From a report by Bruce G. Martin (1914) on the San Sebastian district, the following is taken:

"Unconformably overlying the San Sebastian chert (Eocene), is a series of arenaceous and argillaceous sediments to which the name 'Poso series' is applied. These beds consist of hard to medium soft, coarse-grained, gray sandstone, and sandy clays and a small amount of limestone. Nearly all types and colors of sandstone and clay appear to be represented in this series. The lithology and sequence of beds can be best described by giving a cross-section at right angles to the strike."

Extending easterly from the Cerro de San Sebastian, Mr. Martin's condensed section follows:

d. Alternating hard coarse sandstone and medium grained, sandy shale.....	1000 feet
c. Medium soft, fine grained, bluish gray sandstone and clay, with some concretionary limestone lenses....	1500 feet
b. Medium coarse, hard gray sandstone, and medium soft, blue or gray sandstone.....	900 feet
Total.....	3400 feet

Unconformity

- a. San Sebastian cherts, etc. (Eocene).

His report then continues :

"In the San Sebastian section all the beds have been folded into a monocline which dips rather steeply toward the southeast. The sequence of beds, as here exposed, continues northward for several miles. In a general way these stratigraphic divisions will hold true for the whole area."

Both Mr. Martin and John H. Ruckman described a similar series between the villages of Cocorilla and Purissima. Mr. Ruckman says in part, concerning this district :

"The oldest rocks in the district are undoubtedly the cherts and hardened sandstones of the San Sebastian series (Eocene) which also make up practically the entire mass of the Cerro de Cispata. Overlying these, and in turn hidden by later deposits, there exists a series of very considerable thickness. . . . The concretion-bearing shale and limestone on the Loric-San Antero road represents its lower limit. Upon the limestone are sandstones containing many large, purplish concretions. They also contain considerable limestone in layers, as well as small bits of limestone, possibly representing inclusions from strata beneath. . . . This series of limestones, shales and sandstones is probably, in part at least, equivalent to the Poso series [of Martin]. Overlying the Poso series and overlapping it unconformably upon the San Sebastian cherts, there is a rather thin deposit of chert conglomerate, gravels and poorly consolidated sands. They are not well exposed northwest of Cocorilla, but are unquestionably identical with those farther south near the San Sebastian hills. Fossils obtained from these beds are comparatively recent forms, suggesting correlation with the La Popa (Miocene) group." . . .

Mr. Martin, later describing the district bordering on the Cispata Bay, and about the north end of the Cerro de Cispata, says :

"The rocks of this district belong to two formations; the oldest geologically is the chert formation which makes up the main mass of the Cispata hills. . . . This formation occupies the central part of the hills and probably underlies the chert conglomerate exposed in the small hill immediately north of San Antero. Unconformably upon this chert lies a varying thickness of chert conglomerate and gravelly sandstone. This conglomerate and sandstone appear to be several hundred feet thick along the east slope of the Cispata hills. The size of the chert fragments decreases in going from the base upwards. The sandstone overlying the conglomerate consists almost entirely of small grains of chert. . . . Overlying the conglomerate and cherty sandstone, probably conformably, is a thick series of sandstones, sandy clays, and variously colored soft shales. . . . The upper portion of the series consists mainly of medium soft, argillaceous sandstone with a small amount of thin-bedded shale interstratified with it. These latter beds are well exposed along the crest of the San Antero hills. Another belt of medium hard sandstone occupies a narrow area near the central part of the map, at the gas

springs. The gas escapes from this member of the series. . . . The two largest areas of limestone occur in the south central part of the district. The medium soft, argillaceous sandstone is represented in yellow, the clays and shales in citrine, the basal sandstone and conglomerate in brown, and the chert in red. A peculiar feature of the series is the great lithologic variation."

The Poso series was followed southward up the valley of the Rio Sinú to above Monteria and along the east flank of the Cerros de las Palomas, where sandstones predominate in great thickness. At a locality 12 miles northwest of Cereté the formations are almost exclusively sandstones, often very siliceous, as if derived from underlying cherts. They stand at high angles with a strike of N. 70° E., and a dip of not less than 45° to the northwest. Mr. K. D. White, who visited this district after the writer's visit, says, in part:

"All exposures of rock seen were phases of sandstone. In fact, no outcrops of pure shale were found. The lowest bed, forming the center of the anticline, is massive gray, micaceous sandstone, with interstratified layers of grit, also massive in bedding. The grit members have layers of conglomerate that are typically millstone grit. The entire series is ferruginous; above the grit beds the sandstones become finer grained, more compact and siliceous. Many seepages of petroleum issue from these sandstones."

Concerning a locality some 12 miles west of Cereté, Mr. Martin says:

"All the rocks observed are of sedimentary origin. They consist of shale, soft, sandy clays, fine and coarse grained sandstone, and conglomerate. . . . Thin layers of conglomerate and grit can be seen closely associated with fine sandstone and clay. The colors of these rocks vary from very light gray through blue, gray and yellowish gray to brown. . . . The rocks are well stratified in general, although in places the strata are so greatly crushed that the bedding could not be distinguished from fracture planes. The inclination of the strata varies considerably. . . . Owing to [this fact] no well defined folds could be distinguished. In the vicinity of the gas and oil springs, where more detailed work was done the beds have been crushed and twisted to such a degree that it becomes impossible to recognize any definite structure. . . . The oil here appears to be seeping from greatly crushed clay shale and fine-grained sandstone. Some of the rock fragments have a strong odor of petroleum. The gas springs consist of eight or ten small vents from which small quantities of inflammable gas, water and mud are escaping. . . . Small mud cones from one to three feet high have been built up about the vents."

Farther south and nearly west of Monteria, on the east flank of the Palomas range, the beds are less sandy and show

a disposition to become shaley, but they exhibit the same structural conditions as before. Mr. Martin, who worked in this district, reports in part:

"The younger beds consist of grits, massive sandstone, soft shaley sandstone, and soft mudstones. The grits and massive sandstone are hard and usually thick-bedded. The shaley sandstones and mudstones are thin-bedded and greatly fractured. . . . The rocks are so arranged that three or four distinct lithologic divisions can be distinguished." . . .

His report divides the strata of this district as follows:

- | | |
|--|-----------|
| 1. An upper shale and sandstone member | 1500 feet |
| 2. A sandstone and grit member | 2000 feet |
| 3. A basal shale member | 1500 feet |

Total	6000 feet
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The upper member of this section is probably later in age than the Poso series, and may be Miocene. The lower members are undoubtedly referable to this series. They are of a dark bluish or gray color, are considerably indurated, and are much folded and faulted. The strike is N. 20° E., and the inclination is from 45° to 75°.

There are two or more closely folded anticlines in the area examined and several seepages of petroleum and gas. Concerning these structures, Mr. Martin's report continues:

"Along the axes of the folds the strata are often vertical. In going across the strike away from the axis the inclination gradually decreases, until dips as low as 10° are sometimes found. . . . The sequence of beds is similar over the entire area. Near the axis shales occur in every case. The petroleum [and gas] usually comes out with more or less acrid or sulphurous water, and accumulates on the spot as black asphaltum, the gas springs often forming small mounds of mud, or 'mud volcanoes'."

After an excursion made into the Palomas range, some 30 miles southwest of Monteria, Mr. Ruckman reported:

"Many interesting seepages of oil and gas were found together with many mud volcanoes, characteristic of this region. . . . No igneous or schistose rocks were observed, while jasper and chert occur only as float from the Palomas range."

After describing the sedimentary beds from which the oil and gas were issuing, the report continues:

"This series [of strata] . . . is almost certainly Mr. Martin's 'Poso series.' It is made up of a highly folded series of fine, thin-bedded, or massive, micaceous sandstone, and fine, rather hard, blue-black shale containing calcareous concretions and occasional lenses of limestone. Fragments of chert and limestone, similar to those in the Cerro de Cispata, forming several types of conglomerate were noted along the streams draining the Palomas mountains. The petroleum of all the seepages noted was associated with the shale. . . . On the Quebrada Matamoras there is a very fine seepage of light oil. The oil comes directly from the shale, and evaporates, leaving only a stain on the shale. . . . The seepages extend for 600 feet along the creek, issuing with some gas. The bedrock is almost entirely shale standing nearly vertical, the lowest dip being 45° toward the Palomas mountains, suggesting an overturn."

Rocks of the Poso series occur also near San Andres, though not in the thickness noted in the foregoing quotations. At a point on the San Andres-Momil road, some three miles east of the former place, an outcrop of these beds was noted in 1915. They consist of thin-bedded, dark, sometimes greenish-gray clay shales and nodular, or concretionary, limestones. In places they are gravelly, with pebbles of hard, dark, siliceous rocks, such as occur in the underlying Tofeme member of the Eocene. These shales have a strike of N. 30° E., and dip rather steeply to the southeast. They are overlaid by a brown or rusty-colored sandstone having a similar strike and dip, which, upon further observation, appears to rest unconformably upon the older series. These sandstone beds are fossiliferous, and belong unquestionably to the Miocene (Tubera) group, later described. These two formations are probably represented by the two portions of the "Huertas series" of Beck.

On the coastward side of the Palomas range, the Cerro de Cispata, and the Coloso range, the Poso series is exposed in many localities. At the west foot of the Coloso range there is a series of somewhat indurated, dark clay shales, sandstones, and hard conglomerate, without fossils, as far as observed, folded into a sharply compressed syncline in which the aggregate thickness of strata is not less than 2,500 feet. This section was visited by Mr. Martin and the writer in 1914, and the conclusion was reached that the series was identical with the Poso series of his earlier report. The strike of the beds is roughly parallel with the general line of the coast, or nearly northeast and southwest. Seepages of oil were found

here issuing from shales near the base of the series, as is usually the case.

Similar beds occur about Cispatá Bay to the north and west of the Cerro de Cispatá, and here too are found seepages of gas smelling of petroleum.

The same series outcrops near Paso Nuevo and at other points along the coast. A few miles to the southeast of Monitos, beneath the sandy beds of the Miocene, which here follow the coast, standing at a high angle, there are hard, dark-colored shales and sandstones, also highly inclined (60° to 75°), striking parallel to the coast line, and overlying the Eocene. Their observed thickness was estimated at 1,500 feet, though it is probably more. Beneath are fossiliferous beds of Eocene age, and above are the Miocene sandstones with molluscan fossils.

The shales here described have elsewhere been called the "Monitos shales," probably representing the Oligocene.

Crossing the Rio Canalete somewhat above its mouth, and extending thence into the hills to the east of Córdoba, on the Rio Córdoba, there is a series of dark clay shales and sandstones from which issue many seepages of light oil. This series is not only highly folded and perhaps faulted, but, moreover, the strata are much crushed and crumpled and in places reduced to a structureless complex. Overlying these beds along the coast and extending to the Bay of Arboletes, there are steeply inclined Miocene sandstones and shales with many well preserved fossils.

Near the Bay of Arboletes and near the contact of the two sedimentary series is the great "mud volcano" of this district, rising about 75 feet above the coastal terrace, and covering some 40 acres of area. Much gas escapes from the pool of mud at the top, smelling strongly of petroleum. Not far away outcrop the underlying shales in which are found seepages of oil, and which are probably the source of the gas. The same body of shales extends along the coast for some miles toward the Gulf of Urabá. That this series of shales and sandstones from which issue the oil and gas belongs to the Poso series there can scarcely be a doubt, although no fossils were found in it.

A nearly parallel zone of the same series of strata crosses the Quebrada del Aguila, a tributary of the Rio Canalete, about 15 miles east of the Bay of Arboletes. The locality is known as El Aguila, and is on the coast side of the Palomas range. Here hard sandstones and shales are well exposed, though much broken and faulted, and standing at a high angle. Five or six miles south of El Aguila similar shales and sandstones are exposed in the bed of a small stream, and are less broken by faulting. The strike is about N. 30° E., and the dip is not less than 75° to the northwest. About 1,000 feet of strata are exposed here, from which seepages of oil and gas are issuing. Three miles to the north are the mud volcanoes of San Diego, which cover not less than 40 acres of area. These vents have brought to the surface many fragments of hard sandstone, calcite, limonite, lignite and other mineral débris. The water escaping with the gas is slightly saline.

Many other examples of these formations could be given, though they seem unnecessary. One of their chief characteristics is the presence in them of seepages of petroleum and gas, and the accompaniment of the well-known mud volcanoes of this region. This characteristic, together with their frequent stratigraphic position between Eocene rocks below and often fossiliferous Miocene beds above, serves for their identification even where stratigraphic evidence is not complete.

The oil is believed to be largely indigenous, though in part it may have originated in the underlying Eocene formations, which contain foraminiferal and other organic strata, and in some places are bituminous, though to a less degree than the strata of the Poso series.

Structures. The structural conditions of the Poso series have been already suggested in the foregoing notes and quotations. As a whole the series is highly folded, if not faulted, and it has been much denuded subsequent to its folding. In the range of foothills west of the Rio Sinú, where the series was most studied, there are found two or more somewhat compressed anticlines with intervening synclines on the east slope of the Palomas range, and as many on the westward, or coast slope of the same. Such a fold is found in the vicinity of

Arboletes Bay, and another farther inland. Still others are known in the vicinity of El Aguila and the Lorencita.

Within these highly folded areas of the Poso series other strata both older and younger are involved, and in such cases the boundaries are often uncertain. In fact it would not be easy to disentangle the several series even were the country less covered with jungle and more accessible by roads than it is.

The amount of faulting that has affected these Tertiary areas is not known, though there are many evidences that faulting even on a large scale has disturbed various sections of the country. One such fault has long been recognized, and appears in the section drawn by Beck (p. 465). This is probably the fault that traverses the west foot of the Coloso range, and is known as the "Bolivar fault." The full extent of this fault has not been ascertained, though it is not confined to the locality of the Coloso range. It extends from here southward toward Monteria, and northward toward San Cayetano, and may even connect with the faulting west of Arenal and of Usiacuri.

Stratigraphic relations. The stratigraphic relations of the Poso series to the beds above and below have already been suggested in the foregoing paragraphs. Near Lorica in the Cerro de Cispata as well as in the Cerro de San Sebastian, the Poso series is found resting unconformably upon, or against, the cherts and other rocks of the Eocene. Along the west foot of the Coloso range the Bolivar fault complicates the problem by cutting the formations near the line of boundary between the Eocene and the Poso series, yet the lithologic contrast in the two is easily recognized. Also in the conglomerates of the latter are found many pebbles and boulders of the cherts that characterize the former. No other source than the strata of the Eocene appears to be possible for the pebbles of chert and jasper found in the conglomerates of the Poso series, and this fact, in the absence of direct evidence as to the age of the latter, is sufficient to show that this series is at least post-Eocene.

On the other hand, the Eocene is often richly fossiliferous in both Mollusca and Foraminifera, while the Poso series, with the exception of certain genera of the latter, is rather

poor in fossil remains. In the section drawn by Werenfels⁵ for the district of Toluviéjo, which possibly applies equally well to that of the lower Sinú valley, the "Toluviéjo series," with its fauna of *Lepidocyclina* and *Numulites* species, is tentatively placed by him in the upper Eocene, though most of the genera mentioned in his text seem to have been found in the middle Oligocene of Santo Domingo.⁶ The "Pacini shales" of his section, for which he estimates a thickness of over 3,200 feet, are possibly in part within the Poso series of the present paper, and, moreover, he assigns them to the Oligocene. The lower part of the Poso series, as found near San Antero, consists of calcareous concretionary shales as shown by Mr. Ruckman.

The stratigraphic relations of his several "series," one to the other, are not stated by Werenfels, nor are they indicated in his section. It is not possible, therefore, to fix their position in the scale of the present plan with much confidence, though some suggestions may be offered regarding them. The correlation of the lower part of the Beck column with his "Pacini shales" appears to be erroneous, since the Tofeme formation of Beck is undoubtedly Eocene in age, as shown in a former paper.⁷ May it not be possible that the "Toluviéjo series" of Werenfels is only the lower part of the Poso series, and that the "Pacini shales" correspond to the upper part?

R. H. Liddle has given a "Composite geologic column" for western Venezuela,⁸ in which the "Oligocene" strata of the Maracaibo basin are shown as having a maximum thickness of 5,500 feet, of which the Paují shales, the lower part, constitute more than half.

Only a few mollusks and Foraminifera (chiefly *Lepidocyclina*) are mentioned to "indicate that the formation is of marine and not of deltaic origin."

This group is followed historically by an uplift and erosion interval, while upon it, in some places, rests 1,000 feet of massive coralline limestone and sandy beds, the San Luis formation. Overlying this group is that of the Agua Clara shales,

⁵ Werenfels, A., *Eclogae geol. Helvet.*, vol. 20, 1926, pp. 81-83.

⁶ Vaughan, T. W., and Woodring, W. P., *Geol. Surv. Domin. Rep.*, Mem. vol. 1, 1921, pp. 107, 108, etc.

⁷ Anderson, F. M., *Proc. Calif. Acad. Sci.*, vol. 17, 1928, p. 4.

⁸ Liddle, R. A. *The Geology of Venezuela*, etc. 1928, pp. 54, 241, etc.

sometimes 1,500 feet in thickness. These are described as "dark-gray, sandy, micaceous, locally very fossiliferous shales, which gradually become more sandy toward the top," and passing without visible structural break into the Cerro Pelado formation (Miocene) consisting of "massive or flaggy and shaley sandstones interbedded with arenaceous lignitic shale." Each of these groups is discussed at length in the body of the book, and some indications given as to the faunas of each, together with notes as to their correlations.

Without offering any final judgment as to the faunas and the correctness of the correlations, it may be remarked in passing that the lists of molluscan genera and species given as representing the Agua Clara formation suggest its Miocene age, rather than Oligocene, and its equivalence, in part at least, to the Tuberia group described later. These remarks do not apply, however, to the whole of the San Luis formation, which, according to Liddle, seems to be conformably overlaid by the Agua Clara group.

Concerning the Paují shales, and possibly a part of the San Luis formation, with the large Foraminifera *Lepidocyclina* species, there should be less question as to their Oligocene age. Their stratigraphic body and their fauna both seem comparable to the middle Oligocene of Santo Domingo, as described by Vaughan and Woodring.⁹

Along the Colombian north coast the Poso series described in the preceding pages is regarded as directly comparable to the latter, and therefore, also to the Paují shales and related strata of western Venezuela.

Age of the Poso series. Unconformable relations between the Poso series and the underlying Eocene have already been shown at the type locality of the former near San Sebastian, and in the Cerro de Cispata northwest of Lorica. In the conglomerates of the Poso series on the east slope of the Cerros de Las Palomas are found the cherts and other rocks of the underlying Eocene. Such facts are noted in other parts of the country.

⁹ Vaughan, T. W., and Woodring, W. P., Geol. Surv. Domin. Rep., Mem. vol. 1, 1921, pp. 107-108.

Similar relations between the Poso series and the overlying Miocene were also pointed out in certain localities. Local evidence of such unconformity was found near Lorica as is shown in the report of Mr. John H. Ruckman, and near San Andres as noted on a preceding page.

As for the definite assignment of the Poso series to the Oligocene at the present time there is some reservation. It may be in part Miocene, though there are reasons for believing that the larger part of it is older. The series as a whole is clearly post-Eocene as has been said, and in view of the occurrence of undisputed Oligocene in other Antillean regions it should be expected to occur here also in commensurate volume.

The general absence of molluscan fossils, which are abundant in the Miocene of north Colombia, the more varied lithology of the Poso series, as contrasted with the known Miocene, the frequent occurrence of petroleum or its indications, not observed in the Miocene, and other features that could be mentioned, all suggest not only a different but older age than the Miocene of either of the groups that are described below.

THE MIOCENE SERIES

Regarding the occurrence of Miocene deposits in Colombia, there is more satisfactory evidence than that regarding the Oligocene. On the geologic map of North America Willis shows later Tertiary deposits widely distributed over the northern parts of South America, particularly in the valley of the Orinoco, about Lake Maracaibo and in the valleys of northern Colombia, extending far into the interior of the country, along the Magdalena, the Cauca, the San Jorge and the Cesar rivers, about the Gulf of Urabá and along the west coast. Thence they extend into other countries bordering the Caribbean Sea.

The areas actually covered by Neocene deposits in Colombia are much smaller than that shown on the map, and strictly are confined to relatively narrow zones along the coasts and along some of the larger rivers. For example, marine deposits of Neocene age do extend along the valley of the Magdalena in more or less continuity to the delta areas at the mouths of the Rios Sogamoso and Carare, where marine deposits give place

to only partly marine in the Oponcito group. Above this the Miocene deposits are continuous but transitional in character until they connect with the non-marine deposits of the Barzalo group of the upper Magdalena previously described.¹⁰

A part of the marine Miocene strata of northern Colombia has already been described in earlier papers, though not the entire series. In fact, no complete statement of the marine sequence or of its distribution can be made at present. As for their distribution, the known Miocene deposits extend eastward from the Gulf of Urabá along the Colombian coast to the Sierra Nevada de Santa Marta, and beyond this range they occur again near Rio Hacha, and according to accounts they extend from there southward into the valley of the Rio Cesar, very possibly to its mouth where it connects with the Magdalena. At any rate they are believed to fill the entire valley above its mouth.

Washburn and White¹¹ have given a thick section of Tertiary sediments as occurring in the valley of the Rio Cesar, a large part of which is given a position between the lower Tertiary and the late Pliocene, but as no reference is made to fossils, it is impossible to conjecture what portion of the Miocene column is represented in the section.

Huntley and Mason¹² also give an immense section of presumably marine Miocene strata (after Bossler) as occurring in southwestern Colombia along the Pacific coast. Some of the sandy shales contain fossils, but there is no attempt to indicate what part of the Miocene they represent, if, indeed, it is known.

Eastward from the Gulf of Urabá the marine Miocene deposits are not quite continuous, and are, moreover, involved with older formations and are known only in part, as will be shown later.

Along the lower stretches of the Magdalena north of Mompos fossiliferous marine Miocene deposits underlie most of the surface, but in turn are also overlaid by later deposits, partly land-laid and partly marine. From the Magdalena the

¹⁰Anderson, F. M., *Bull. Geol. Soc. Am.*, vol. 38, 1927, pp. 612, etc.

¹¹Washburn, C., and White, K. D., *Tr. Am. Inst. Min. Met. Eng.*, vol. 68, 1923, p. 1026.

¹²Huntley, L. G., and Mason, S., *Tr. Am. Inst. Min. Met. Eng.*, vol. 68, 1923, p. 1018.

Miocene deposits extend westward into the valley of the Rio San Jorge, and from there they pass into the valley of the Sinú, which they occupy in part. About the lower Sinú valley they enter into the composition of the lower hills near the coast, and possibly connect with the deposits along the coast about the Gulf of Morrosquillo. Miocene deposits overlie the Poso series near San Onofre and southward from this village toward Tolu and the Bay of Cispata. Along the coast to the southwest of Cispata Bay they appear again near Punta Piedras, Monitos, Bruquelles, Mangle, the Bay of Arboletes and farther toward the Gulf of Urabá, and along the Atrato river.

In all these points beyond the Bay of Cispata the strata stand at a high angle dipping toward the sea, and with a strike nearly parallel with the coast line. For the most part they appear to be only sparingly fossiliferous, though enough fossils have been found for the definite determination of the middle part of the Miocene. On the Quebrado de Murindo, a tributary of the Rio Canalete, some 15 miles from the coast, fossiliferous beds occur, standing at high angles, as will be described later, from which numerous molluscan species have been obtained.

In the districts about the lower Magdalena the Miocene deposits attain a great development, and a thickness much in excess of that found by the writer in other parts of the Colombian coast. In a former estimate of an incomplete section to the west of the river the thickness was given as 5,400 feet, or more. Other writers have given the thickness of the Miocene series in certain parts of the country as near 8,000 feet, but without detailed information as to the strata or the contained faunas.

Later study of the section in the district west of Barranquilla necessitates some modification of the divisions formerly proposed, since the apparent thickness is somewhat increased by faulting.

Briefly, three distinct groups of strata have been recognized here as shown below, of which the central group constitutes at least half the entire series as known at present. They are approximately, as follows:

Galapa (La Popa) group.....	1650 feet
Tuberá group.....	2650 feet
Las Perdices group.....	1000 feet
<hr/>	
Total.....	5300 feet

Las Perdices group. In the earlier statement¹³ referred to above there is a brief description of some 400 feet of strata outcropping near Las Perdices; about 15 miles west of Barranquilla, which appeared to be of Miocene age, but which also appeared to be separated from the overlying Tuberá group by a disconformity. No definite name was proposed for these beds, but in the present paper the above name is proposed. The group as here exposed consists of clay shales, sandy shales and hard cherty, or siliceous beds and some sandstone.

The shales contain at this locality a few species of Mollusca, scales of fishes and bone fragments, sponge spicules and numerous Foraminifera, as mentioned in the former account. Samples of these shales were examined by Dr. G. Dallas Hanna, and his note regarding these forms is here included for completeness:

"The shales contain a very considerable number of fossils, the groups being represented about as follows in order of abundance: (1) Radiolaria; (2) Diatomaceæ; (3) Foraminifera; (4) Sponges; other organisms are scarce. There has been pyritization to a considerable extent and many of the chambers of the fossils are filled with iron sulphide. A great many of the diatoms have been replaced entirely and internal casts of the frustules are abundant. *Coscinodiscus* was the only genus definitely identified in this group. Many of the genera and some of the species of Radiolaria are the same as have been found in the famous deposit on Barbados Island and which Payne has put definitely in the Miocene. Some of the genera are: *Stylodictya*, *Histiastrum*, *Stylosphæra* and *Eucyrtidium*. Foraminifera are scattered rather sparingly through the mass of the material, the common genera being: *Globigerina*, *Orbulina*, *Lagena*, *Truncatulina*, *Cassidulina*, *Nodosaria*, *Anomalina*, *Fron-dicularia*, *Plectofrondicularia* and *Bolovina*. It is believed that these organisms offer a means whereby a definite correlation can be made with strata of known age elsewhere. This preliminary examination indicates that the formation lies very close to the base of the Miocene, if, in fact, it is not the lowermost part of the sediments of that period."

A few miles to the north of this locality and west of Puerto Colombia, similar shales are exposed along the sea cliffs for a mile or more, with a strike of nearly east to west, and a dip

¹³Anderson, F. M., Proc. Calif. Acad. Sci., vol. 16, 1927, p. 88.

toward the south of 40° to 60°, and are here overlaid by fossiliferous sandstones of the succeeding group, which also dip southward. The underlying shales contain a variety of microorganisms, among which are Foraminifera, scales of fishes, the following molluscan fauna and coral:

<i>Cancellaria</i> , new species.	<i>Turris albida</i> (Perry)
<i>Mitra mauryæ</i> Anderson, new species	<i>Cassidulus</i> (<i>Phalium</i>) <i>dalli</i> Anderson,
<i>Scobinella morierei</i> (?) (Laville)	new species
<i>Polinices prolactea</i> Anderson, new species	<i>Drillia eupora</i> Dall
<i>Psammobia</i> (<i>Gari</i> ?)	<i>Dentalium granadanum</i> Anderson,
	new species
	<i>Cyathomorpha</i> sp.

While most of the species are new, and therefore not at present serviceable for correlation, yet they are definitely of Miocene aspect; a few of them indicate a low position in this series. From the stratigraphic evidence they clearly belong beneath the Tuberá group, and are regarded as a northward extension of the Las Perdices group.

Some 10 miles to the west of Barranquilla, and extending to the southwest, the lowest beds of the Miocene are brought to the surface along the axes of a series of anticlinal folds, faulted in part, extending from near Puerto Colombia to the vicinity of Cienega de Oro, a total distance of over 100 miles. Beds believed to be Oligocene are also brought up beneath the Miocene.

Near the village of Usiacuri the lowest beds exposed consist of clay shales, shaley sandstone, and calcareous layers, in all some 600 feet in thickness which constitute a distinct stratigraphic group. These strata are here rather poor in molluscan remains, though microscopic marine organisms have been noticed in some of them. From such remains as have been found they are believed to be Miocene in age, and in part equivalent to those exposed along the beach west of Puerto Colombia, and at Las Perdices, or in other words to represent the Las Perdices group, as described above.

Near the top of this group at Usiacuri, springs of sulphurous water issue from the strata, which give to this village its repute as a health resort. The water is bottled and sold in the neighboring towns as a health beverage. Here the lower group terminates above by a lithologic change in the character

of the sediments, which become suddenly more sandy, and at the same time they also acquire a rich fauna of marine Mollusca.

The line of separation between the Las Perdices group and the succeeding group here is probably near the springs of sulphurous water, or immediately below the village, which is situated on the east flank of the fold. No angular unconformity in the strata was found here, though it is suggested by the lithologic change, the abrupt appearance of the marine Mollusca, and by the springs of sulphurous water.

The thickness of the Las Perdices group is not at present known, though between Usiacuri and the axis of the fold to the west the exposed thickness of strata is probably not less than 1,000 feet. In other parts of the country it is believed to be greater.

From a comparison of the three localities thus far studied it can be said that a disconformity is indicated, and that it probably can be fully demonstrated by further work in this field.

Olsson described a disconformity between the Uscari formation of Costa Rica and the overlying Gatun,¹⁴ and an overlap of the latter upon the older rocks of the region. Similar relations exist with regard to the Tuberá group as was shown by Mr. Ruckman's account of the district about the lower Sinú valley. The stratigraphic position of this disconformity in the Colombian Miocene seems to be lower than the base of the Gatun group as found in the Canal Zone. However, this disconformity has not been shown to exist in the Canal Zone, unless the Emperador limestone should prove to belong properly to a higher horizon than has usually been conceded for it. Vaughan has suggested that it may possibly find a place among the equivalents of the Langhian (Burdigalian) of Europe.¹⁵ May it not also be possible that the Uscari formation of Olsson and the Las Perdices group of the present paper, when fully known, will find a similar place in the sequence of Antillean stratigraphy?

The Tuberá group. In the earlier paper to which reference has been made the writer gave a brief summary of the

¹⁴ Olsson, A. A., Bull. Am. Pal., vol. 9, 1922, p. 784.

¹⁵ Vaughan, T. W., Bull. Geol. Soc. Am., vol. 35, 1924, p. 731.

Colombian marine Miocene deposits as found in the vicinity of the lower Magdalena valley. On the basis of its fossil zones it was divided into horizons, lettered respectively from M to T in ascending order.

The name *Tuberá group* was first suggested for this sequence of strata in 1926¹⁶ but without any definite delimitation. Later the name was employed in a more definite treatment,¹⁷ and while recognizing the three distinct fossil horizons, namely M - N, P, and R, the faunal contents of only the lower, M - N, was given, consisting of some 64 species of Mollusca. A tentative correlation of this and the succeeding horizons was suggested, but without elaboration, since for the two upper horizons no faunal lists were given.

The sequence of strata embraced in the *Tuberá group* has a thickness of not less than 2,650 feet. It consists for the most part of incoherent sandstones and sandy shales, divisible into some local lithologic members, though none that seems to have any great areal extent. No conspicuous and essentially organic members have been discovered.

The fossil horizons probably have greater geographic range and stratigraphic value. The group is well represented about *Tuberá* mountain and its environs, whence the name. Of the sequence forming this group, horizon M - N is, at its type locality, confined to the lower 550 feet. Horizon R falls within the upper 600 feet, while horizon P occupies a position near the middle, and is probably embraced within a stratigraphic range of 300 to 400 feet.

Between these several horizons the beds are somewhat barren of fossils, in the immediate district about *Tuberá* mountain, and in fact as far as known elsewhere along the coast.

In its geographic distribution the *Tuberá group* extends over a wide region, and it appears to represent the more usual facies of the Colombian Miocene, whereas the older group has been definitely detected only within restricted areas. Within the limits of north Colombia this group has been recognized at such distant points as the Gulf of Urabá, Arboletes Bay, Rio Canalete, Lorica, San Andres, Zambrano, El Banco, Turbaco, Cartagena, Punta Pua, *Tuberá* mountain, and along the

¹⁶Anderson, F. M., Bull. Amer. Assoc. Petrol. Geol., vol. 10, 1926, pp. 387 & 399.

¹⁷Anderson, F. M., Proc. Calif. Acad. Sci., vol. 16, 1927, pp. 87-90.

west flank of the Sierra Nevada de Santa Marta. However, it is believed to extend much farther, as into the valleys of the Rio San Jorge and the Rio Cesar. Only a few of the localities in which the group occurs can be considered in detail at the present time.

Local occurrences. Among the several districts in which the Tuberá group has been proved is that of the upper drainage of the Quebrada Murindo, a tributary of the Rio Canalete draining the west slope of the Las Palomas range. The district lies some 12 to 15 miles from the coast and somewhat farther from Monteria. Mr. K. D. White, who visited this district, describes in detail a sharply folded anticline traversing it in a north to south direction, on the opposite sides of which he gives stratigraphic sections respectively 3,000 and 5,000 feet in thickness. Of these B - B is much the less complete, since it does not reach the axis of the fold. Section C - C crosses the axis upon which are found various seepages of oil, not found on the other.

Of the latter section some 2,300 feet of the lower part is not fossiliferous. Fossils are found throughout section B - B, but through only the upper part, 2,700 feet, of section C - C. These sections are respectively represented by the numbers 354 and 355, from which were obtained the following partial lists of species:

Loc. 354 (C. A. S.)

Pitaria tryoniana (Gabb)
Cardium dominicense Gabb
Cardium venustum (?) Gabb
Chama scheibei Anderson
Pecten vaginulus (?) (Dall)
Cyclinella gatunensis Dall
Conus consobrinus Sowerby
Conus molis Brown & Pilsbry
Turritella altilira Conrad
Fusinus henekeni (Sowerby)
Terebra cirra Dall
Serpulorbis sp.

Loc. 355 (C. A. S.)

Pitaria cora (Brown & Pilsbry)
Cardita scabricostata Guppy
Cardium lingualeonis (?) Guppy
Cyclinella gatunensis Dall
Tellina cibaoica (?) Maury
Arca trinitaria Guppy
Polinices subclausa Sowerby
Oliva gatunensis Toulou
Potamides avus Brown & Pilsbry
Bullaria paupercula Sowerby
Strombus proximus Sowerby
Strombina sp.

Many other species could be added to these lists, but the number is perhaps sufficient. The lithologic character of the strata from which they come is similar to that of the Tuberá

group, and is in contrast with the underlying barren beds in which the seepages of oil occur along the axis of the fold.

Near San Andres the Tuberá group is represented by sundry localities, containing representative species, as the following:

Loc. 302 (C. A. S.), four miles south of San Andres	Loc. 303 (C. A. S.), three miles east of San Andres
<i>Cylichnella gatunensis</i> Dall	<i>Chione walli</i> Guppy
<i>Mactrella elegans</i> (Sowerby)	<i>Tellina gatunensis</i> (Toula)
<i>Natica guppyana</i> Toula	<i>Surcula servata</i> Conrad
<i>Architectonica gatunensis</i> (?) Toula	<i>Arca</i> sp.
Loc. 350 (C. A. S.) Arboletes Bay	
<i>Tivela mactroides</i> (Born)	<i>Bullaria paupercula</i> (Sowerby)
<i>Cardium linguleonis</i> Guppy	<i>Olivella indivisa</i> Guppy
<i>Cardium haitense</i> Sowerby	<i>Potamides avus</i> Brown & Pilsbry
<i>Chione mactropsis</i> (Conrad)	<i>Bittium adele</i> Dall

At the hamlet Jesus del Monte, between Carmen and Zambrano, near the base of the Miocene were obtained:

<i>Turris albida</i> (Perry)	<i>Natica guppyana</i> (?) Toula
<i>Cancellaria</i> sp.	<i>Turritella altilira</i> (?) Conrad
<i>Arca</i> sp.	<i>Glycymeris</i> sp.

At the village of El Banco on the Rio Magdalena, some 170 miles above Barranquilla, a zone of crystalline rocks crosses the course of the stream. On the east flank of this zone at the mouth of the Rio Cesar, and immediately beneath the village, there are soft yellowish brown sandstones overlaid by blue clay shales forming a part of a thicker series which presumably rests upon the pre-Tertiary crystalline rocks, which crosses the river to the west. The sandstones have a gentle dip, 6° to 8°, to the eastward. One stratum is largely composed of broken and decomposed marine shells, but beneath this are sandstones from which better preserved fossils may be obtained. Only a few species were collected, but a number of genera were recognized in these beds, including, *Arca*, *Glycymeris*, *Chione*, *Ostrea*, *Anomia*, *Pecten*, *Olivella*, *Turritella*, *Terebra*, *Phos*, *Polinices* and many others. None of the species characteristic of the lower horizon of the Tuberá group were found, while nearly all of them were such as are found abundantly in the higher beds, horizon P of this group.

In view of the occurrence of the older crystalline rocks to the west, and the easterly dip of the Miocene beds, this occurrence may be regarded as belonging to the Tertiary area of the valley of the Rio Cesar, rather than to that of the lower Magdalena. The crystalline rocks here may be interpreted as forming a connecting link between the pre-Tertiary area of the Sierra Nevada and that of the Cordillera Central, as stated elsewhere.

Comparison of horizons. At most places in Colombia where the Miocene beds have been noted by other writers they have been indiscriminately mentioned as representing the Gatun formation of the Canal Zone, though the definite basis for this view has not been given. However, in truth, most of the accessible exposures do represent horizons above that of M - N, the lowest part of the Tuberá group. Whether this fact is due to overlap of the later horizons beyond the limits of the lower, or to other circumstances of deposition can not now be stated.

On the basis of faunal content only the middle portion of the Tuberá group should be regarded as the equivalent of the Gatun formation of the Canal Zone. The expansion of the name "Gatun" to include all of the Miocene sequence, even where the sequence is a conformable series, does not appear to the writer as justifiable.

The number of molluscan species obtained from the entire group by the writer has not exceeded 165, though from lists published by Dr. Pilsbry and others the total number could be considerably increased. Of the entire number obtained 38 species are added in the present contribution as new species, and doubtless many others will subsequently be found.

The stratigraphic range of many of these forms is of course not known at present. Some of them doubtless range throughout the Miocene while others are of short stratigraphic duration.

For the purpose of correlation a list of 86 of the better known species have been selected from the total number as being most representative. This list segregates the species as to horizons, as far as known at present. Little more than a tentative attempt is claimed for the segregated lists as they here appear.

Species	Tuberá Group			Other Regions		
	M-N	P	R	Cer- cado	Ga- tun	Tam- pa
<i>Terebra sulcifera</i> Sowerby.....	*					
<i>Terebra gatunensis</i> Toula.....				*	*	
<i>Terebra cirra</i> Dall.....				*		
<i>Terebra haitensis</i> Dall.....		*		*		
<i>Terebra bipartita</i> Sowerby.....						*
<i>Conus sewalli</i> Maury.....		*		*	*	
<i>Conus imitator</i> Brown & Pils.....	*	*			*	
<i>Conus molis</i> Brown & Pils.....	*	*	*	*	*	
<i>Conus recognitus</i> Guppy.....		*	*	*	*	
<i>Conus planiliratus</i> Sowerby.....	*					
<i>Conus stenostomus</i> Sowerby.....	*			*	*	
<i>Turris albida</i> (Perry).....	*	*		*	*	
<i>Drillia eupora</i> Dall.....						*
<i>Cancellaria dariena</i> Toula.....		*			*	
<i>Cancellaria guppyi</i> Gabb.....		*		*		
<i>Cancellaria cossmanni</i> Olsson.....		*			*	
<i>Turritella altilira</i> Conrad.....	*	*			*	
<i>Turritella perattenuata</i> Heilp.....	*					
<i>Turritella fredeai</i> Hodson.....	*	*				
<i>Turritella mimetes</i> Brown & Pils.....		*			*	
<i>Turritella gatunensis</i> Conrad.....		*			*	
<i>Turritella cartagenensis</i> Brown & Pils.....		*				
<i>Crucibulum gatunense</i> (Toula).....		*			*	
<i>Architectonica granulata</i> (Lamarck).....		*			*	
<i>Architectonica quadriseriata</i> (Sow.).....		*		*	*	
<i>Natica guppyana</i> Toula.....	*	*			*	
<i>Natica cuspidata</i> Guppy.....	*					
<i>Polinices subclausa</i> Sowerby.....		*	*	*	*	
<i>Calliostoma grabau</i> Maury.....	*		*	*		
<i>Calliostoma olssoni</i> Maury.....		*	*			
<i>Oliva cylindrica</i> Sowerby.....	*	*		*	*	
<i>Oliva sayana</i> Ravenel.....		*	*		*	
<i>Oliva brevispira</i> Gabb.....	*	*		*		
<i>Marginella ballista</i> Dall.....		*				*
<i>Marginella conformis</i> Sowerby.....		*			*	
<i>Mitra dariensis</i> Brown & Pils.....		*			*	
<i>Mitra longa</i> Gabb.....	*	*		*		
<i>Scobinella morierei</i> (Laville).....					*	
<i>Fasciolaria kempi</i> (Maury).....	*	*			*	
<i>Fusus heneken</i> (Sowerby).....			*	*		
<i>Murex domingensis</i> Sowerby.....		*		*		
<i>Murex mississippiensis</i> Conrad.....		*				*

Species	Tuberá Group			Other Regions		
	M-N	P	R	Cer- cado	Ga- tun	Tam- pa
<i>Typhis siphonifera</i> Dall.		*				*
<i>Distortrix simillima</i> (Sowerby)		*	*		*	
<i>Cyprea henekeni</i> Sowerby.	*				*	
<i>Cyprea gabbiana</i> Guppy.		*				
<i>Malea ringens</i> (Swainson)		*	*		*	
<i>Sconsia lævigata</i> (Sowerby)	*	*		*	*	
<i>Strombina chiriquiensis</i> Olsson.		*			*	
<i>Serpulorbis papulosa</i> Guppy.	*	*				
<i>Serpulorbis granifera</i> (Say)		*				
<i>Petalocochnus sculpturatus</i> Lea.	*	*			*	
<i>Arca patricia</i> Sowerby.	*	*		*?		
<i>Arca macdonaldi</i> Dall.	*	*			*	
<i>Arca actinophora</i> Dall.		*			*	
<i>Arca dariensis</i> Brown & Pils.		*			*	
<i>Arca lloydi</i> Olsson.		*			*	
<i>Glycymeris jamaicensis</i> Dall.	*	*				
<i>Glycymeris carbasina</i> Brown & Pils.					*	
<i>Glycymeris lamyi</i> Dall.		*			*	*
<i>Ostrea megadon</i> Hanley.	*	*				
<i>Pecten mortoni</i> Ravenel.	*	*			*	
<i>Pecten demiurgus</i> Dall.	*					
<i>Pecten pinulatus</i> Toulal.	*				*	
<i>Pecten bowdenensis</i> Dall.		*				
<i>Spondylus bostrychites</i> Guppy.	*			*		*
<i>Crassatelites densus</i> Dall.	*	*				*
<i>Venericardia brassica</i> Maury.	*					
<i>Cardita arata</i> (Conrad)	*					*
<i>Cardita scabricosta</i> Guppy.	*	*	*	*	*	
<i>Echinochama antiquata</i> Dall.	*	*		*	*	
<i>Cardium domingense</i> Gabb.		*			*	
<i>Cardium lingualeonis</i> Guppy.	*	*				
<i>Cardium gorgasi</i> Hanna.	*		*		*	
<i>Cardium serratum</i> Linnaeus.		*			*	
<i>Cardium venustum</i> Gabb.		*				
<i>Dosinia delicatissima</i> Brown & Pils.		*			*	
<i>Dosinia acetabulum</i> (?) Conrad.		*			*	
<i>Clementia dariena</i> (Conrad)	*	*			*	
<i>Cyclinella gatunensis</i> Dall.			*		*	
<i>Cyclinella cyclica</i> (Guppy)		*				
<i>Antigona caribbeana</i> Anderson.	*	*			*?	
<i>Antigona blandiana</i> (Guppy)	*	*				
<i>Calloccardia gatunensis</i> Dall.		*			*	

Species	Tuberá Group			Other Regions		
	M-N	P	R	Cer-cado	Ga-tun	Tam-pa
<i>Pitaria circinata</i> (Born).....			*		*	
<i>Pitaria cercadica</i> Maury.....	*		*	*		
<i>Macrocallista maculata</i> Linnæus.....	*	*			*	*
<i>Chione nuciformis</i> Heilprin.....		*				*
<i>Chione mactropsis</i> (Conrad).....	*	*			*	
<i>Chione latilirata</i> (Conrad).....	*	*				
<i>Tellina dariena</i> Conrad.....		*			*	
<i>Tellina gatunensis</i> (Toula).....	*	*			*	
<i>Semele sardonica</i> Dall.....		*				*
<i>Mactrella elegans</i> (Sowerby).....	*					
<i>Labiosa gibbosa</i> (Gabb).....		*	*			
<i>Labiosa gardneræ</i> Spieker.....		*	*			

Galapa-La Popa group. In the table of correlations here included, above the uppermost horizon of the Tuberá group there is a considerable sequence of beds the exact position of which in the column may be subject to debate. On account of their apparent conformity with the Tuberá group they are here regarded as of Miocene age, though they may be younger. Such beds are found in the neighborhood of Galapa to the south of Barranquilla, and also at the base of La Popa hill near Cartagena. Near Galapa they consist of little consolidated beds of calcareous sandstone, while at La Popa hill and about the Harbor of Cartagena they consist of well-stratified but somewhat incoherent sandy shales and clays with calcareous layers of marl.

In the former locality the strike is generally N. 20° E. and the dip is easterly. The thickness is not definitely known, though an estimate of 1,650 feet is believed to be conservative. They are rich in marine fossils, among which *Pecten* predominates although *Dosinia*, *Cardium*, and various gastropod forms have been found.

The La Popa formation found in the vicinity of Cartagena has an aggregate thickness of 1,000 feet, or more, though it is not well exposed. The structural condition exhibited in these deposits is at variance with those of Galapa, in that the dis-

trict is traversed by east to west faults that produce scarps of some prominence, as seen in the south face of La Popa hill itself, and in the north face of the hill of Cospique on the east side of the Harbor.

In the syncline lying between the Tuberá-Piojo uplift and the coast similar beds are found of which the contained fossils cannot now be given.

These beds do not appear to cover the general areas of the older Miocene, but are local and are, as far as known, confined to districts near the present coast. None have been observed far inland. Not only are they conformable upon the Tuberá group in the districts where they have been observed, but they participate in the structural features of the latter.

From the fact that they are not coextensive with the Tuberá group, but are local in their occurrence, it may well be surmised that they do not form a continuous series with it, but may be separated from it by an unconformity the significance of which should not be overlooked. Possibly an uplift of the land areas near the close of the Miocene excluded the sea from the larger part of the region previously covered by it. For these reasons it would be well to reserve final judgment as to the proper position of the Galapa group until more data are obtained than the writer possesses at the present.

PLIOCENE DEPOSITS

Contrary to the view expressed in the preceding paragraphs, the late Miocene epoch has often been regarded as one of uplift for the general region of the Caribbean. This was at one time apparently the view of Dr. Vaughan,^{17a} in whose conception an extensive emergence of land areas in late Miocene time was followed by warping and local submergence during the Pliocene, concerning which he says in part:

"Subsequent to the Miocene there have been many oscillations of the West Indian area, and during perhaps Pliocene time there was profound deformation."

In the same paper Dr. Vaughan regards the Toro limestone of the Canal Zone as of Pliocene age, and with it classes

^{17a} Vaughan, U. S. Nat. Mus. Bull. 103, 1919, pp. 608-609.

also certain deposits of Limon, Costa Rica, and others far to the east. Concerning the district about the lower Magdalena with which the present paper deals, he says (p. 594) :

"Mr. George C. Matson collected at Barranquilla, Colombia, some fossils that belong to a fauna younger than that obtained around Usiacuri, and may be of Pliocene age."

The rocks classed tentatively as Pliocene by the present writer are abundant around Barranquilla and the mouth of the Magdalena. A good section is found along the railroad between Puerto Colombia and Salgar. The strata here undulate, but on the whole dip 10° eastward along the shore. The following sequence is the result of careful study of the beds exposed here:

d. Upper coral limestone.....	250 feet
c. Incoherent sandstones.....	350 feet
b. Lower coral limestone.....	160 feet
a. Sandy clay shales.....	150 feet
<hr/>	
Total thickness.....	910 feet

These limestones contain a great variety of corals and many Mollusca including *Cypraea*, two species of *Codakia*, many species of *Pecten*, oysters, and various gastropods. The coral limestones resemble that in the quarries at Barranquilla, and, in fact, their connection is not difficult to trace on the surface. In these quarries which are worked for lime, there is a greater variety of corals than on the beach, and also of Mollusca. Here and in most places the corals and shells are largely reduced to the condition of soft marls in which are some harder layers and lenses of coral rock. These beds may be followed along the Galapa road for many miles, where they are almost always horizontal in attitude. They seem to have been at one time more extensive toward the west but have suffered much denudation, leaving the limestone more or less local in its present occurrence.

Quite similar beds cover the top of La Popa hill near Cartagena, but here rise to an elevation of some 500 feet above the sea and have an inclination of about 15° or more toward the north. They form here a distinct reef, 75 to 80 feet in

thickness, resting upon marly shale of about equal thickness which is underlaid by the sandy shales of the La Popa formation. Beds of the same character cover the top of the hill of Cospique, and occur also at Turbaco at an elevation of about 500 feet above the sea. Corals and molluscan shells are abundant in all of these points, and are usually reduced to characteristic marl.

These supposed Pliocene deposits with coralline reefs of the sort here described occur at intervals along the Colombian coast, apparently not always resting upon the same horizon of the Miocene. Such beds are found on the island of Terra Bomba, Isla de Baru, Bayunca, and at points beyond the Bay of Cispata.

The general attitude of these coral reefs and the associated beds does not appear to be harmonious with the underlying Miocene. They were not observed above an altitude of 500 feet, while the Miocene often rises to much greater heights. The deposits appear to be in some respects, and in some places, unconformable upon the underlying Miocene, though a clear case of unconformity was not found.

With regard to age there are some general stratigraphic facts that may be mentioned. Elevated beaches and late Quaternary deposits of beach origin skirt the hills near sea level, and Quaternary gravels form old valley floors in many parts of the country and along the coasts. Such deposits are nearly always horizontal, and clearly have no relation to the supposed Pliocene deposits, except to show their distinctly more recent origin.

Only a few of the fossil corals so abundant and varied in these deposits have received any attention. Three species only have been noted from the reef on La Popa hill. On a visit to Cartagena in 1898 the Princess Theresa von Bayern personally went to the summit of La Popa hill and collected four specimens of coral from the reef that caps the same. These corals were left at the Academy of Sciences at Munich, and were later described by Herr Johannes Felix, under the following names :

Orbicella theresiana Felix

Isastræa turbinata Duncan

Stephanocænia fairbanksi (?) Vaughan

Concerning the first of these species Dr. Vaughan says that it is "probably a synonym of *Solenastrea bournoni* M. Edwards & Haime." Felix was unable to reach any conclusion as to age from his study of these corals, though he thought they were probably Miocene.

CORRELATIONS

While exact correlations of the Colombian Tertiary groups and horizons with others of the Caribbean and Central American regions can not yet be made with complete confidence, a tentative attempt, based upon known facts may be well worth while.

On the whole the Miocene series and groups seem to correspond fairly well with those of Santo Domingo, as for example the Yaque group, with the possible exception of its lowest member, the Baitoa formation, containing species of *Orthaulax* and associated forms. The fauna of the Las Perdices group is not yet well known, but with further search it may well prove to be the equivalent of the Baitoa, as suggested in the accompanying table. Horizon M - N of the Tuberá group lacks the species that characterize the Baitoa formation, and that are found in similar lower Miocene deposits of the Gulf Coast which have been correlated with it. On the other hand, a comparative study of its fauna shows horizon M - N of the Tuberá group to be more closely related to the Cercado formation of the Yaque group than to any of the others, as the following statements will show.

Of the 64 molluscan species thus far found in this horizon, only 15 appear in the list from the Gatun formation given by Brown & Pilsbry, as enumerated by Vaughan.

Of the species found in the Cercado formation, according to Maury, something more than 5 per cent are found also in the recent Antillean fauna. Of the 64 species of horizon M - N, not more than four are also found in the living faunas of the Pacific and Caribbean seas, and the number may be less. In any case it will not exceed 7 per cent of recent species, and this estimate is liberal.

Horizon P of the Tuberá group shows even stronger resemblance to the Gatun formation of the Canal Zone. Of the

CORRELATION TABLE

Pliocene	Canal Zone	Costa Rica	Jamaica	Santo Domingo	North Colombia	Florida	Europe
	Limon Bay limestone (MacDonald)	Limon, Monk. Point, Bocas conglomerate (Olsson)		Las Matas stage	Top of La Popa, Cartagena, Salgar and Barranquilla marl	Caloosahatchee marl, etc.	
Miocene		"Upper Gatun" (Olsson)		Cerro de Sal (South side)	Galapa group, Base of La Popa, Arbolete (in part) T 1650'	Jacksonville formation	Sarmatian
	Gatun beds 500 ft. (MacDonald)	"Typical Gatun" (Olsson)	Bowden marl	Mao Clay Mao Adentro limestone Gurabo formation (Sconsia laevigata)	S 200' R 600' Q 450'		Tortonian
		"Lower Gatun" (Olsson)		Cercado formation (Aphera isiacolonis)	P 400' O 450'	Unconformity Shoal River Oak Grove Chipola marl (Orthaulax sp.)	Helvetian
	Emperor limestone ?	Unconformity Uscari stage (Olsson)		Baitoa format'n (Orthaulax sp.) Bulla conglom.	M-N 550' 2650'	Alum Bluff	Upper Langhian Lower Langhian
Oligocene	Culebra ? Bohio conglomerate		Trelawny limestone	Cervicos limestone	Las Perdices group 600'-800'	Tampa beds (Orthaulax sp.)	Aquitanian
					Poso Series ?	Marianna limestone	Chattian

86 species contained in the foregoing lists from the Tuberá group, 37 are common to horizon P and the Gatun group, and of these 24 do not appear in the older beds of horizon M - N. Among the species not found in horizon M - N, but which appear to characterize the next fossil horizon and the Gatun as well, as found at the Spillway, are the following:

<i>Malea ringens</i> (Swainson)	<i>Clementia dariena</i> (Conrad)
<i>Sconsia lavigata</i> (Sowerby)	<i>Callocardia gatunensis</i> Dall
<i>Distortio simillima</i> (Sowerby)	<i>Arca actinophora</i> Dall
<i>Mitra dariensis</i> Brown & Pilsbry	<i>Arca dariensis</i> Brown & Pilsbry
<i>Conus sewalli</i> Maury	<i>Tellina dariana</i> Conrad
<i>Cancellaria dariana</i> Toulà	<i>Dosinia delicatissima</i> Brown & Pils.
<i>Crucibulum gatunense</i> (Toulà)	<i>Cardium domingense</i> Gabb
<i>Turritella mimetes</i> Brown & Pilsbry	<i>Cardium serratum</i> Linnæus

To these others could be added, but are perhaps unnecessary. An indirect evidence of their equivalency gives even better support.

Although A. A. Olsson¹⁸ appears to have expanded the "Gatun group" to include beds both higher and lower than the strata found at the Spillway of the Canal, he counts no less than 334 species, of which he says about 13 per cent are identical, or closely related, to recent species. Of the 117 species found in horizon P, 15 are represented in the recent faunas on the two sides of the Isthmus, or about 12.8 per cent, a figure very close to that of Olsson.

Continuing the parallel comparisons, it can perhaps be shown that the equivalents of the Bowden fauna are to be found in horizon R of the Tuberá group, and above it, though this is not apparent in the foregoing lists.

The correlations suggested in the table for the series older and younger than the Miocene are tentative only, and have been sufficiently discussed in the preceding pages, the former under the heading of Stratigraphic relations of the Poso series, and the latter under other appropriate headings, to which little can be added here.

¹⁸ Olsson, A. A., Bull. Amer. Pal., vol. 9, 1922, pp. 183, 188, etc.

DESCRIPTION OF SPECIES

On the following pages are noted most of the species that have been recognized in the marine Miocene groups of north Colombia, but without any claim of supplying an exhaustive list of the same. Without the aid of large collections of material from these groups that are available for comparison in other institutions of the country, much reliance has necessarily been placed upon published figures and descriptions which presumably were intended to be adequate for this purpose. Some of the Miocene forms from the Carribbean region have, unfortunately, been illustrated by unsatisfactory figures, but where this is the case the author of such has little ground for complaint if other writers fail to recognize his species. In many such cases later writers have gratuitously supplied better figures, and where this has been done recourse has been had to them. Photographic illustrations are thus available in the valuable contributions of Miss Maury, A. A. Olsson, W. P. Woodring, Dr. Pilsbry and his co-workers, and by others, so that one need not often go astray in his determinations of the better known forms.

As might have been expected from the backward state of paleontologic study in the marine Miocene of South America, some new species have been brought to light, and when the material has justified it these new forms have been entered in the lists with proper description. In addition, a few forms already known from other Antillean regions have been illustrated with, or without description when this has seemed desirable.

The order in which the species have been taken up is almost without regard to any scheme of taxonomy, but merely that of a convenient arrangement of the forms noted.

GASTROPODA

1. *Terebra sulcifera* Sowerby

Terebra sulcifera SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 47; Miocene, Santo Domingo.—GUPPY, (part) Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 525, pl. 29, fig. 8; Loc. as above.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 186, pl. 3, fig. 12; Loc. as above.

This species is the largest of the *Terebras* found in the Caribbean Miocene, one incomplete specimen of 10 whorls measuring 95 mm. in length and 22 mm. in width near the base. If complete, this specimen would have a length of over 120 mm. In size, as well as in the sculpture of the mature shell, this form resembles *T. petiti* Maury (not *T. petiti* Kiener), though the younger shells clearly have the sculpture described by Maury for *T. sulcifera* Sowerby, and these features are shown in the younger whorls of all the examples.

This species was found at Loc. 267, C. A. S., in horizons M - N and R, and accordingly at the base and near the top of the Tuberá group, and presumably its range is throughout the same.

2. *Terebra clethra* (?) Maury

Terebra clethra MAURY, Monog. Foss. Ter. Brazil, vol. 4, 1925, p. 198-9, pl. 10, fig. 3; Lower Miocene, Rio Pirabas.

Maury's type of this species was either of a small and rare form, or it was the earlier whorls of a larger species. The figure is said to have been drawn from a cast. Two specimens found near Usiacuri, Loc. 306, both incomplete, are 65 mm. in length, if entire. In form and ornamentation they resemble Maury's type too nearly to permit their separation at present.

3. *Terebra gatunensis* Toula

Terebra (Oxmyeris) gatunensis TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 705, pl. 25, fig. 14; Gatun formation, Canal Zone.

Terebra gatunensis, BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 339, pl. 22, fig. 2; Gatun formation, C. Z.—MAURY, Bull. Am. Pal. vol. 5, 1917, pl. 4, fig. 5; Cercado de Mao, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 208, pl. 1, figs. 4, 5, 6; Gatun stage, Canal Zone.

This species was found in the clay shale near the top of the Tuberá group, horizon R, to the west of the Tuberá mountain.

4. *Terebra cirra* Dall

Terebra (Acus) bipartita SOWERBY, variety *cirrus* Dall, Proc. U. S. Nat. Mus., vol. 18, No. 1035, 1895, p. 38. River Amina, Santo Domingo; Miocene.

Terebra (Oxymeris) bipartita DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, pl. 59, figs. 13, 28, 29; Miocene, Santo Domingo.

Terebra cirra DALL, MAURY, Bull. Am. Pal., vol. 5, 1917, p. 189, pl. 3, fig. 17; Miocene, Santo Domingo.

This species has been found at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group, and at Loc. 306, C. A. S., at the eastern border of Usiacuri village at about the same horizon. It has been collected also at Loc. 299, C. A. S., two miles southwest of Baranoa; Loc. 325 and 325-A, C. A. S., all representing horizon P of the Tuberá group, of the Colombian Miocene.

5. *Terebra haitensis* Dall

Terebra (Hastula) haitensis DALL, Proc. U. S. Nat. Mus., vol. 18, 1895, p. 35.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 35, pl. 59, fig. 30; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 207, pl. 1, fig. 3; Gatun Stage, Costa Rica.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 194, pl. 4, fig. 4; Cercado de Mao, Miocene, Santo Domingo.

This species has been obtained at Loc. 299, southwest of Baranoa, and at Loc. 351, C. A. S., near Punta Pua, both near the middle of the Tuberá group of the Colombian Miocene.

6. *Terebra bipartita* Sowerby

Terebra bipartita SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 47; Miocene, Santo Domingo.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 187, pl. 3, fig. 14; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal. vol. 9, 1922, p. 207, pl. 1, figs. 1, 2; Miocene, Costa Rica.

Terebra (Acus) bipartita SOWERBY, DALL, Proc. U. S. Nat. Mus., vol. 18, 1895, p. 38; not *T. (Oxymeris) bipartita* (Sow.) Dall, 1903, pl. 59, figs. 13, 28, 29, loc. cit.

This species has been found at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group, 20 miles north of Cartagena.

7. *Conus sewalli* Maury

Conus sewalli MAURY, Bull. Am. Pal., vol. 5, 1917, p. 201, pl. 5, fig. 3; pl. 6, fig. 3; Cercado de Mao, Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 220; Gatun Stage, Canal Zone, Panama.

Excellent examples of this shell were obtained at the Spillway of the Canal in 1914; it has since been found at two localities in northern Colombia, namely, Loc. 304, C. A. S., four miles east of Santa Rosa, and at Loc. 351, C. A. S., near Punta Pua. Both are at central horizons of the Tuberá group.

8. *Conus veatchi* Olsson

Conus veatchi OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 216, pl. 2, figs. 5, 8; Gatun Stage, Canal Zone, Panama.

Only a single imperfect example of this species was found, and it was obtained at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group, at the west foot of Tuberá mountain.

9. *Conus imitator* Brown & Pilsbry

Conus imitator BROWN & PILSBRY, Proc. Acad. Nat. Sci., Phila., vol. 63, 1911, p. 342, pl. 23, fig. 4; Gatun formation.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 217, pl. 2, fig. 6; Gatun Stage, Canal Zone, Miocene, Costa Rica.

This species was found at various localities in the Colombian Miocene. In many respects it resembles *C. chipolanus* Dall, from a low horizon of the Gulf Coast. It occurs at Loc. 267, C. A. S., horizon M - N; Loc. 325-A, C. A. S., near Cibarco; Loc. 351, C. A. S., near Punta Pua; most of these are at central horizons of the Tuberá group.

10. *Conus molis* Brown & Pilsbry

Conus molis BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 343, pl. 23, fig. 1; Miocene, Canal Zone.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 200, Cercado de Mao, Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 214, pl. 2, figs. 1, 2; Miocene, Costa Rica.

This species occurs quite abundantly in the Tuberá group of the Colombian Miocene, but can not be regarded as a horizon marker. It has been obtained at Loc. 267, C. A. S., horizon M - N; horizon P, and horizon R; also at Loc. 299, near Baranoa; Loc. 304, C. A. S., near Santa Rosa; and Loc. 351, C. A. S., near Punta Pua. Its occurrence is therefore at nearly all horizons of the Tuberá group.

11. *Conus granozonatus* Guppy

Conus granozonatus GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 16, fig. 5; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 222, pl. 3, fig. 15; Gatun Stage, Costa Rica.

A single good specimen of this species was obtained at Loc. 351, C. A. S., near Punta Pua. It is slightly larger and more robust than appears in either Guppy's or Olsson's figures, although in other respects the identification is satisfactory.

12. *Conus recognitus* Guppy

Conus solidus SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 45; Miocene, Santo Domingo; not *C. solidus* Sowerby, Conch. Illust., 1841, pl. 56, No. 76.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 16, fig. 1; Miocene, Jamaica.

Conus recognitus GUPPY, Proc. Sci. Assn. Trinidad, 1867, p. 171.—GUPPY, Geol. Mag., vol. 1, 1874, p. 409; new name proposed.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 527.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1583.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 209, pl. 7, fig. 9; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 218, pl. 2, fig. 9; Miocene, Costa Rica.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 327, pl. 19, fig. 2; Miocene, Santo Domingo.

This species is one of the most abundant in the Tuberá group of the Colombian Miocene. Like *C. molis*, it is not regarded as a horizon marker, since it is found at various levels. It has been obtained at Loc. 267, C. A. S., horizons

P and R, and at Loc. 325-A, and 351, C. A. S., the latter of which is central in the Tuberá group.

13. *Conus planiliratus* Sowerby

Conus planiliratus SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 44.
—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 16, fig. 7; Miocene, Santo Domingo.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1583.

A single specimen of *C. planiliratus* was obtained at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group. It has not been found at any other horizon, as far as known.

14. *Conus stenostomus* Sowerby

Conus stenostomus SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 44; Miocene, Santo Domingo.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 16, fig. 2.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 203; Cercado de Mao, Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 214, Gatun Stage, Canal Zone.

Only a single good example of this species was obtained at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group, at the west foot of Tuberá mountain. According to Olsson, it occurs in the Gatun Stage of Port Limon, and Maury lists it from the upper Miocene of Springvale, Trinidad Island.

15. *Conus concavitectum* Brown & Pilsbry

Conus concavitectum BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 341, pl. 23, figs. 5, 6; Gatun formation, Canal Zone.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 215; Gatun Stage, Canal Zone.

Three specimens of this species were obtained at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, which horizon is believed to closely represent the Gatun horizon of the Canal Zone, Panama.

16. *Conus burckhardti* (?) Böse

Conus burckhardti BÖSE Bull. Inst. Geol. de Mex., No. 22, 1906, p. 50, pl. 5, figs. 39, 40.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 224, pl. 3, figs. 4, 5; Miocene, Gatun Stage, Panama.

A single specimen of *Conus* that seems referable to the Mexican species was obtained at Loc. 351, C. A. S., near Punta Pua. In this example the spire is distinctly different from that of Böse's species in having the upper surface of the whorls rounded, or somewhat angulated along a median line, thus forming a succession of sloping steps, rather than a smooth, regular slope. In most respects, however, the shell closely resembles the Mexican form. A number of well preserved examples of *C. burckhardti* was obtained at the Spillway of the Canal in 1914, though none of them show the form of spire noted in the present example.

17. *Conus consobrinus* (?) Sowerby

Conus consobrinus SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 45.
—GUPPY, Geol. Mag., vol. 1, 1874, p. 409, pl. 17, fig. 3.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 203, pl. 6, figs. 5, 6; Miocene, Santo Domingo.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 330, pl. 20, figs. 7, 7a, 7b; Miocene, Santo Domingo.

Two examples of a *Conus* found at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, closely resemble Sowerby's species, although there are some differences of sculpture in the last whorl. In our examples the minute beads on the spiral ribs are rounded instead of being elongated, as in Sowerby's form. The lines of growth are arcuate, and in other respects the characters are nearly identical with those of Sowerby's species.

18. *Conus tortuosopunctatus* Toula

Conus (Cheliconus) tortuosopunctatus TOULA, Jahrb. der K. K. Geol. Reichs., Wien, Bd. 61, 1911, p. 507, pl. 31, fig. 21, b.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 226, pl. 3, figs. 6, 11; Gatun Stage, Canal Zone.

It would appear from the figures given by Toula and Olsson that the height of spire in this species is variable, as is so often the case. In our examples the spire is intermediate in height between the extremes found in these figures. In other respects the identification is completely satisfactory. These samples come from Loc. 351, C. A. S., near the middle of the Tuberá group, probably near the horizon of P, at Tuberá mountain.

19. **Conus tuberculata** Anderson, new species

Plate 9, figures 4, 5

Shell of medium size, probable height of holotype (incomplete) 54 mm., width 3.4 mm., spire high, concavely turritid, earlier whorls coronated; last two or three whorls smooth, but slightly excavated above; sides of older specimens smooth, in younger shells the sides are adorned with minute spirally arranged beads, chiefly on the lower half of the shell; aperture narrow. The shoulders of the last whorl sharp and abrupt; lines of growth strongly curved.

This shell resembles *C. consobrinus* Sow., only in sculpture, but is relatively wider, has less strongly developed granulations on the sides. It also differs from *C. toroensis* Olsson in relative width and in form of spire.

Holotype: No. 4623, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon M - N, **near base of the Tuberá group**, where it appears to belong, and where several fair-sized specimens were obtained; Miocene of Colombia.

20. **Conus crenospiratus** Anderson, new species

Plate 9, figures 6, 7

Shell small, height of holotype 17 mm., width 10 mm., with graceful outline, low spire and somewhat rounded sides; in size, form and sculpture it recalls *C. isomitratatus* Dall, from the Chipola beds of Florida; upper surface of the whorls flattened; sutures distinctly incised, but unlike Dall's species, the shoulders of the whorls are tuberculated, forming on the inner side of the suture a wavy, or crenulated line; body whorl ornamented by spiral lines, which become obsolete near the shoulder, but become stronger on the lower third of the whorl; spiral threads are here flattened, or slightly concave in section, having the appearance of being double.

Holotype: No. 4624, Mus. Calif. Acad. Sci., from Loc. 351, C. A. S., **near Punta Pua**, near the middle of the Tuberá group, Colombia; Miocene.

21. *Turris albida* (Perry)

Pleurotoma albida PERRY, Conch. Expl., 1811, pl. 32, fig. 4.—DALL, Bull. Mus. Comp. Zool., Harvard College, vol. 18, 1889, pp. 72-73.—Trans. Wag. Fr. Inst. Sci., vol. 3, 1890, p. 28, pl. 4, fig. 8a.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 343; Miocene, Canal Zone.

Turris albida, DALL, Bull. U. S. Nat. Mus., No. 90, 1915, p. 38, pl. 5, fig. 13; pl. 14, fig. 7; *Orthaulax pugnax* zone, Lower Miocene, Miss., and Santo Domingo.—MAURY, Bull. Am. Pal., vol. 5, 1917.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 230, pl. 4, figs. 1, 2; Gatun Stage, Canal Zone, Panama.

This species has been obtained at Loc. 267, C. A. S., horizon M - N, at Loc. 351, C. A. S., near the middle of the Tuberá group, and at Loc. 266, C. A. S., on the Quebrada Juan de Acosta, near the top of the Tuberá group. Its range is, therefore, throughout the entire group, and it can not, accordingly, be regarded as a horizon marker.

22. *Drillia eupora* Dall

Drillia eupora DALL, Bull. U. S. Nat. Mus., No. 90, 1915, p. 42, pl. 5, fig. 3, Tampa Bay, Florida.

Among the fossils collected from the Las Perdices shale one mile west of the pier at Puerto Colombia, Loc. 267, C. A. S., horizon L, is an incomplete example of *Drillia* which includes most of the spire. One whorl is missing, though the axis itself is complete. When entire, the shell was composed of at least 13 whorls, including the nuclear portion, forming an elongated, narrow, gently tapering spire. The penultimate whorl has 18 vertical ribs of the form described by Dr. Dall, crossed by revolving threads, five in number, and a subsutural collar bordered by a carinated ridge. The resemblance of this shell to Dall's figure, reinforced by his description, permits no other identification. This species does not appear to have been recognized before in the Miocene of the Caribbean borders, though doubtless subsequent work will reveal its presence in other parts of the region.

23. *Cancellaria karsteni* Anderson, new species

Plate 10, figures 7, 8, 9

Shell of moderate size, biconic in outline, heavy ribbed on the last whorls, spinose on the shoulders; height of holotype 33 mm., width of body whorl 22 mm.; spire high and sharp, forming somewhat more than half height of shell; surface marked by heavy vertical ridges, of which there are about nine on last whorl; these crossed by low revolving threads, with occasional intermediary lines; shoulders of whorl armed with strong spines, rising from the vertical ribs, pointing upward and outward; upper surface of body whorl concave, rising on preceding whorl in a sort of clasping collar with wavy border; aperture somewhat quadrilateral; outer lip angulated near shoulder, and also midway between shoulder and terminus of canal; inner lip thinly calloused, bearing three oblique plications; umbilicus closed.

Holotype: No. 4630; *paratype*: No. 4631, Mus. Calif. Acad. Sci., from Loc. 267 (C. A. S. Coll.), horizon P, at the north end of Tuberá mountain, Colombia; Miocene. It is also found at Loc. 305, C. A. S., near Turbaco, near the middle of the Tuberá group, Colombia; Miocene.

24. *Cancellaria hettneri* Anderson, new species

Plate 10, figures 5, 6

Shell large, height of holotype 42 mm., width 28 mm., somewhat biconic in outline, heavily ribbed on the body whorl with irregular ridges extending to the base; spire high, subconic; upper slope of whorl rising in a collar, not quite clasping, but slightly channelled or flattened above; surface ornamented by revolving threads of three orders, heavy, intermediate and light; shoulders of whorls showing low spines directed outwardly; aperture subquadrate, narrowed above, terminating below in a straight canal; umbilical chink distinct, but closed.

This species is allied to *C. harrisi* Maury, but is more coarsely sculptured, larger, and more spinose.

Holotype: No. 4629, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., from horizon P, north slope of Tuberá mountain, Colombia; Miocene. Two good specimens were obtained at this locality.

25. *Cancellaria dariena* Toula

Cancellaria dariena TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 704, pl. 28, figs. 1, 2; Gatun formation, Canal Zone.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 345, pl. 24, figs. 1-4.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 69, 1917, p. 32; Gatun formation, Canal Zone.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 252, pl. 6, fig. 8; Gatun Stage, Costa Rica.

This species has not been found abundantly in the Colombian Miocene, but it has been obtained at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group.

26. *Cancellaria scheibei* Anderson, new species

Plate 10, figures 1, 2, 3, 4

Shell large, robust, ovate in outline, smooth, with low spire; height of holotype 54 mm., greatest width 40 mm.; spire low, conical, sloping up from rounded shoulders; suture distinctly channelled; whorls about five, the younger three obscurely cancellated; aperture subovate, narrowed above, terminating below in a narrow, slightly curved canal; outer lip sharp, lirate within near the outer edge; inner lip strongly calloused, bearing three plications, the upper two being more widely separated, with three elongated beads on the pillar intervening.

Holotype: No. 4627, Mus. Calif. Acad. Sci., from Loc. 306, C. A. S., from near Usiacuri, Colombia; *paratype*: No. 4628, Mus. Calif. Acad. Sci., from Loc. 304, C. A. S., near Santa Rosa, Colombia; Miocene.

This form remotely resembles *C. lævescens* Guppy, but is larger, smoother, more rounded, and has plications that are distinctly different from Guppy's species. It is more nearly related to *C. solida* Sowerby,¹⁹ found living on the Pacific

¹⁹ Sowerby, J. de C., Proc. Zool. Soc. Lond., vol. 2, 1832, p. 50.—Sowerby, Thes. Conchy., vol. 2, p. 440, pl. 92, fig. 4.

coast from Panama to the Gulf of California. The essential difference may be one of descent, and of senility in the living form. The earlier form is larger, more robust, has a more rugose columella, with bead-like denticles intervening between the plaits, as already described.

This shell is apparently not abundant, but it has been obtained at Loc. 304, C. A. S., near Santa Rosa; Loc. 306, C. A. S., near Usiacuri; Loc. 325-A, C. A. S., near Cíbarco. It has not yet been found at the lowest horizon of the Tuberá group, though a near ally does occur there.

27. *Cancellaria codazzii* Anderson, new species

Plate 14, figures 4, 5, 6, 7

Shell of medium size, height of holotype 30 mm., width 18 mm., biconic in outline, with numerous vertical ribs extending from suture to base; spire high, with five whorls below nuclear ones; nuclear whorls three, quite smooth; surface beautifully cancellated, with revolving threads at nearly equal intervals crossing the numerous vertical ribs in low, rounded bead-like nodes; upper surface of whorls slightly concave, rising in a collar-like expansion, not clasping; concave surface bearing a few revolving threads; suture distinctly channelled; shoulder of whorl not coronate, but bearing a wavy cord; aperture ovate, terminating in a narrow canal; outer lip simple, lirate within; inner lip not distinctly calloused, bearing three oblique plications on the pillar.

Holotype: No. 4645; *paratype*: No. 4646, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., near Cíbarco, Colombia; Miocene, near the middle of the Tuberá group.

This shell is named in honor of Agostino Codazzi, explorer, surveyor, writer, and author of the first authentic map of Colombia.

28. *Cancellaria cibarcola* Anderson, new species

Plate 14, figures 1, 2, 3

Shell of medium size, resembling in most respects *C. scheibei*, but smaller and less rotund. Its three nuclear whorls are quite smooth; its disposition toward a truly cancellated

sculpture in the young stages is more pronounced than in the preceding, and the spiral threads often show clearly on the fifth whorl below the nuclear ones. In outer form it recalls *C. laevescens* Guppy, from which, however, it is readily distinguished by the arrangement of the plaits on the pillar. Two elongated denticles intervene between the upper and second plait which are widely separated. The internal lirations of the outer lip extend deeply into the interior, and the spiral threads become more distinct at the base of the body whorl. These features serve to distinguish this species from either of the preceding. Height of holotype 32 mm., width of body 22 mm., height of aperture 25 mm.

Holotype: No. 4643; *paratype*: No. 4644, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., near Cibarco, Colombia; Miocene.

This shell is found at all of the lower horizons of the Tuberá group, and is a fairly abundant form. It has been obtained at Loc. 267, C. A. S., horizons M - N, P and R; Loc. 299, 304, 325-A, and 351, C. A. S., the latter representing a central horizon in the Tuberá group.

29. *Cancellaria cossmanni* Olsson

Cancellaria cossmanni OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 253, pl. 6, figs. 9, 11; Gatun Stage, Costa Rica.

This species has not been found abundant in Colombia. A single specimen was obtained at Loc. 325-A, near Cibarco, about the middle of the Tuberá group. Its range is not known.

30. *Cancellaria moorei* (?) Guppy

Cancellaria moorei GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 289, pl. 17, fig. 7; Miocene, Jamaica.

A single specimen that seems referable to Guppy's species was obtained at Loc. 306, C. A. S., at the east border of Usiacuri village above the middle of the Tuberá group. In spite of the fact that this species has not often been recognized in the faunas of the Caribbean region outside of the Bowden

beds, the resemblance of the sample from Loc. 306 to Guppy's original figure does not permit of any other determination at present.

31. *Cancellaria guppyi* Gabb

Cancellaria guppyi GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 236; Miocene, Santo Domingo.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 228, pl. 10, figs. 7, 8; Cercado de Mao, S. Domingo.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 333, pl. 22, fig. 7; Loc. as above.

In his Revision of Gabb's Tertiary Mollusca Dr. Pilsbry figures the type (or a lectotype) of this species. The rotund form and regularly cancellated sculpture are its striking characteristics. A single specimen was found at Loc. 267, C. A. S., horizon P, near the middle of the Tuberá group.

32. *Turritella altilira* Conrad

Plate 17, figures 4, 5

Turritella altilira CONRAD, Pac. R. R. Repts., vol. 6, 1857, pt. 2, p. 72, pl. 5, fig. 19; Miocene, Isthmus of Panama.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 358, pl. 27, figs. 2, 3; Gatun formation, Canal Zone.—OLSSON, Bull. Am. Pal., vol. 9, 1922, pp. 321, 322, pl. 14, figs. 4, 8, 9, 14; Miocene, Canal Zone.—HODSON, Bull. Am. Pal., vol. 11, 1926, p. 214, pl. 26, figs. 1, 4, 7, etc.; pl. 27, figs. 2-7; Miocene, North Venezuela.

This shell is abundant in the Colombian Miocene. It is interesting to note that both Maury²⁰ and Olsson²¹ regard *T. tornata* Guppy, as a varietal form of this species, and that Cossmann admits²² that his *T. guppyi* is the equivalent of *T. tornata*, all of which beliefs seem to be well founded. Toulou, furthermore,²³ regards his *T. gabbi* as being nearly related to *T. altilira* and *T. tornata*.

The species occurs plentifully at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, and in higher horizons of the same. It has been found also at Loc. 351, C. A. S., near Punta Pua, and at Loc. 305, C. A. S., near Turbaco, and at

²⁰ Maury, C. J., Bull. Am. Pal., vol. 10, 1925, pp. 382-383.

²¹ Olsson, A. A., Bull. Am. Pal., vol. 9, 1922, p. 323.

²² Cossmann, M., Rev. Crit. de Pal., 1909, p. 225.

²³ Toulou, F., Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 695.

Loc. 354, Quebrada de Murindo, a tributary of the Rio Canalete.

Plesiotype: No. 4658, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon M - N, base of Tuberá mountain, Colombia; Miocene.

33. *Turritella perattenuata* Heilprin

Turritella perattenuata HEILPRIN, Trans. Wag. Fr. Inst. Sci., vol. 1, 1887, p. 88, pl. 8, fig. 13; Pliocene, Caloosahatchie beds, Florida.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1900, p. 316, pl. 16, figs. 5, 9; Loc. as above; —var. *præcellens* PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 69, 1917, p. 36, pl. 5, fig. 12; Miocene, near Cartagena.

This species has not often been listed among the forms found in the Miocene of the Caribbean region but it nevertheless occurs at a number of Miocene horizons in Colombia. It has been found abundantly at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, at Loc. 347, C. A. S., near Turbaco, and in the uppermost beds of the Miocene near Galapa; it occurs also in the position of horizon P, at Loc. 306, C. A. S., near Usiacuri. It is therefore found at most of the fossil horizons of the Tuberá group.

34. *Turritella fredeai* Hodson

Plate 17, figure 1

Turritella robusta GRZYB. var. *fredeai* HODSON, Bull. Am. Pal., vol. 11, 1926, p. 13, pl. 5, fig. 3; pl. 6, fig. 5; pl. 7, figs. 1, 6, 7; Miocene, Northern Venezuela. Not *T. robusta* Gabb, Geol. Surv. Calif., Pal. vol. 1, 1864, p. 135, pl. 21, fig. 94; Cretaceous of California. Not *T. (Haustator) robusta* Grzyb., upper Zorritos, Peru.

Turritella abrupta SPKR., ANDERSON, Proc. Calif. Acad. Sci., vol. 16, 1927, p. 89; horizon M, Tuberá group, Colombia. Not *T. robusta*, var. *abrupta* Spieker, Johns Hopkins Univ. publ., Geol. No. 3, 1922, p. 85, pl. 4, fig. 6; Zorritos formation, northern Peru.

Plesiotype: No. 4175, Mus. Calif. Acad. Sci., from Loc. 351, C. A. S., near Punta Pua, 20 miles north of harbor of Cartagena, Colombia; Miocene.

Spieker's form from northern Peru has been renamed by Hanna & Israelsky²⁴ as *T. supraconca*, as explained below.

²⁴ Hanna, G. D. & Israelsky, M., Proc. Calif. Acad. Sci., vol. 14, 1925, p. 59.

When the writer listed the Colombian form as probably identical with the Peruvian of Spieker, Hodson's recent paper had not yet reached us. A comparison of the Colombian forms with Hodson's figures clearly shows their identity, while his illustrations serve as well to distinguish the northern form from the Peruvian. The specific name "*robusta*" had already been employed at the date of Spieker's writing, and Hodson's form must take the name of his supposed variety.

This species has been found at Loc. 267, C. A. S., horizon M - N, the lowest horizon of the Tuberá group, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, also in a low horizon. It occurs, however, in higher beds, as at Galapa, near the top of the Miocene section.

35. *Turritella mimetes* Brown & Pilsbry

Turritella mimetes BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 357, pl. 27, fig. 1; Miocene, Canal Zone.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 321, pl. 14, fig. 5; Gatun Stage, Canal Zone.

This species is not uncommon in the Gatun group of the Canal Zone where it was obtained by the writer in 1914. It occurs also at Loc. 325, C. A. S., near Baranoa, near the middle of the Tuberá group.

36. *Turritella gatunensis* Conrad

Turritella gatunensis CONRAD, Pac. R. R. Repts., vol. 6, 1857, pt. 2, p. 72, pl. 5, fig. 20; Miocene, Isthmus of Panama.—TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 694; Miocene, Canal Zone.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 358, pl. 27, figs. 4, 5, 9; occurrence as before.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 320, pl. 14, figs. 12, 13; Miocene, Costa Rica, etc.

This shell was obtained at the Spillway in considerable numbers by the writer in 1914, and has since been found plentifully in the Tuberá group of Colombia. It occurs at Loc. 267, C. A. S., horizons P and R. It has been obtained also at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group, and at Loc. 305, near Turbaco, about central in the group, and at Loc. 306, near Usiacuri, in a position near the middle of the section.

37. *Turritella cartagenensis* Brown & Pilsbry

Turritella cartagenensis BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 69, 1917, p. 34, pl. 5, fig. 13; Miocene, near Cartagena.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 385, pl. 42, fig. 13; Miocene, Trinidad Island.

? *Turritella bifastigata*, HODSON, Bull. Am. Pal., vol. 11, 1926, pp. 48-50, pl. 30, figs. 1-6; Miocene, northern Venezuela.

This is one of the most abundant forms of *Turritella* found in the Tuberá group. Hodson has described and figured varieties of a *Turritella* under the name *T. bifastigata* Nelson, from the Miocene of northern Venezuela. The type of Nelson's species came from the Tertiary (probably Miocene) of Peru, but was described without any illustration whatever. Hodson's figure (pl. 30, fig. 1) is from a lectotype not supplied by Nelson. It should be pointed out, however, that the varieties, supposedly of this *Turritella*, as figured by Hodson are such as would include *T. cartagenensis* Brown & Pilsbry, which itself shows variations of the same character.

This species has been obtained from Loc. 306, C. A. S., near the village of Usiacuri; Loc. 351, C. A. S., near Punta Pua; Loc. 353, C. A. S., near the Bay of Cartagena; and Loc. 325-A, near Cíbarco. Its vertical range is nearly central in the Tuberá group.

38. *Crucibulum (Dispotæa) gatunense* (Toula)

Plate 13, figures 4, 5, 6

Capulus ? *gatunensis* TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 692, pl. 25, figs. 1, 2; Gatun formation, Canal Zone.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 360; Gatun formation, Canal Zone.

Two good examples of this hitherto imperfectly known species were obtained from the Spillway of the Canal in 1914, and are now in the collections of the California Academy of Sciences. The coiled apex is smooth, showing only faint lines of growth, but two mm. below the apex the shell becomes corrugated, at first by irregular squamose vertical threads, radiating downward, interrupted by uneven lines of growth. These radial markings become more irregular with growth,

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forming a roughened, granular, radially marked surface. The outline of the base is sub-elliptical, with sharp, faintly crenulated margin. Toulà's samples did not permit him to see the interior of the shell, but in ours the interior is clearly exposed in both examples. The shell possesses a well formed internal cup, semilunar in outline, attached to the wall of the shell on about one-third of its periphery, or in fact, is formed by the wall of the shell itself. This feature places it in the sub-genus *Dispotæa* (Say) Conrad, as has been stated by Dall.

Plesiotypes: Nos. 4639, 4640, Mus. Calif. Acad. Sci., from Loc. 323, C. A. S., **Gatun locks at Spillway, Panama**; Miocene.

A somewhat fragmentary example of this species was found at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group.

39. *Architectonica granulata* (Lamarck)

Solarium granulatum LAM., An. s. Vert., vol. 7, 1822, p. 3.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1892, p. 329.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 295, pl. 23, fig. 3; Miocene, Santo Domingo.

Cadran (= *Solarium*) *granulatum*, KIENER, Icon., vol. 1, 1873, p. 4, pl. 2, fig. 2.

Solarium gatunense TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 693, pl. 25, fig. 3; Miocene, Canal Zone.

Architectonica granulata, DALL, Proc. U. S. Nat. Mus., vol. 37, p. 232; living, Lower California to Panama.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 326, pl. 13, figs. 10-12; Miocene, Canal Zone, etc.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 388, pl. 40, fig. 1; Miocene, Trinidad Island.

This species occurs abundantly in the Tuberá group of the Colombian Miocene. Good examples have been obtained at the following places in northern Colombia:

Loc. 266, C. A. S., Juan de Acosta creek, near Puerto Colombia; Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain; Loc. 299, C. A. S., near Baranoa, near the middle of the Tuberá group; Loc. 305, C. A. S., near Turbaco; and finally, Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group. It thus appears that the vertical range of this species is confined to the middle part of the Tuberá group.

40. *Architectonica quadriseriata* (Sowerby)

Solarium quadriseriatum SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1850, p. 51, pl. 10, figs. 8a, b, c.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 291.—GUPPY, Geol. Mag., vol. 1, 1874, p. 438; Miocene, Santo Domingo.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1585; Miocene, Florida.

Architectonica quadriseriata, GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 228.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 389; Miocene, Trinidad Island.

Good examples of this species were obtained at the Spillway of the Canal in 1914, and it has since been found at Loc. 305, C. A. S., near Turbaco, and at Loc. 325-A, C. A. S., near Cibarco, in both places near the middle of the Tuberá group, or at horizon P.

41. *Natica guppyana* Toula

Natica (Stigmaulax) guppyana TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1909, p. 696, pl. 25, fig. 6; Miocene, Canal Zone.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 360.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 328, pl. 13, figs. 13-15; Gatun beds, Canal Zone, Panama.

A large number of samples of this species was obtained at the Spillway of the Canal in 1914, and are now in the collections of California Academy of Sciences. Equally good specimens have since been obtained from various localities in northern Colombia, as the following:

Loc. 267, C. A. S., horizon M - N, west foot of Tuberá mountain; Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain; Loc. 325, C. A. S., near Usiacuri village; Loc. 325-A, near Cibarco; and Loc. 351, C. A. S., near Punta Pua.

In most of these localities the samples came from a horizon near the middle of the Tuberá group.

42. *Natica cuspidata* Guppy

Natica cuspidata GUPPY, Agr. Soc. Trin. and Tobago, Ppr. No. 454, 1910, p. 5, pl. 2, fig. 4; Reprint, Bull. Am. Pal., vol. 8, 1921, p. 162, pl. 8, fig. 4; Miocene, Trinidad I.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 391, pl. 40, figs. 9, 10; Loc. as before.

Two examples of this seemingly rare shell were found in the lowest horizon, M - N, of the Tuberá group, at Loc. 267, C. A. S., associated with many heavy shelled littoral species.

43. *Polinices subclausa* Sowerby

Natica subclausa SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 51; Miocene, Santo Domingo.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 290, pl. 18, fig. 8.—GUPPY, Geol. Mag., vol. 1, 1874, p. 437.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 519; Loc. as before.

Polinices subclausa, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1585.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 360.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 300, pl. 23, fig. 14; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 329, pl. 13, figs. 16, 17; Miocene, Canal Zone, Panama.

In 1914 the writer obtained a few samples of this species at the Spillway of the Canal. Since then others have been obtained at Loc. 266, C. A. S., Arroyo Juan de Acosta, near the top of the Tuberá group, and at Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain.

44. *Polinices stanislas-meunieri* Maury

Polinices stanislas-meunieri MAURY, Bull. Am. Pal., vol. 5, 1917, p. 300, pl. 23, figs. 15, 16; Miocene, S. Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 329, pl. 13, fig. 7; Gatun Stage, Canal Zone.

A large number of samples of this species has been found in the Tuberá group. It occurs in the following localities:

Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain; Loc. 325, C. A. S., east border of Usiacuri village; Loc. 325-A, C. A. S., near Cibarco, and Loc. 351, C. A. S., near Punta Pua.

45. *Polinices prolactea* Anderson, new species

Plate 14, figures 8, 9

Shell of moderate size, subglobose, with low spire, open umbilicus, conspicuous callus, highly polished; aperture sub-lunar, narrowing behind to a subacute angle; callous rather heavy on the posterior part of the inner lip; narrowing to a

thin line near the anterior part of the aperture; surface marked by lines of growth, and near the base of the shell by faint spiral striations, not always visible.

Several good examples of this species were obtained at Loc. 267, C. A. S., in the Las Perdices beds below the Tuberá group, a mile west of Puerto Colombia.

Holotype: No. 4648, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon L, **Los Perdices group, Puerto Colombia; Miocene.**

The nearest ally of this shell is *Polinices lactea* (Guilding), now living in the neighboring Bay of Cartagena. G. B. Sowerby has described a similar near relative from the coast of Chile as *Natica solida*.²⁵

46. *Ampullaria tuberacola* Anderson, new species

Plate 16, figures 1, 2, 3

Shell subovate, at least when full grown, deeply perforate, spire low in mature shells, whorls five or six, shell thin and with a deficiency of calcareous matter; umbilicus open, funnel-form, angulated on the borders in adult shells; suture distinct and slightly impressed; upper surface of the whorls rounded and convex; shoulder of last whorl sharply rounded, sides sloping toward the narrow base, making the form of the shell somewhat conical; height of holotype 52 mm., greatest width 48 mm.

Holotype: No. 4655; *paratype:* No. 4656, from Loc. 267, C. A. S., from horizon R, **Tuberá village, Colombia; Miocene.**

The younger shell is more nearly sub-globose and bears a strong resemblance to *A. (Pomus) canaliculata* Lam., from Tropical America. Two examples of this shell were found at Tuberá village, Loc. 267, C. A. S., associated with many strictly marine forms, such as *Conus recognitus*, *Malca ringens*, *Ficus colombiana*, etc. It is quite probable that these non-marine shells were brought into this association by streams from a neighboring shore to the southwest.

²⁵ Geol. Observ. Darwin, Append. pt. 2, p. 612, pl. 3, figs. 40, 41.

47. *Calliostoma grabau* Maury

Calliostoma grabau MAURY, Bull. Am. Pal., vol. 5, 1917, p. 319, pl. 24, fig. 19; Zone G, Rio Gurabo, S. Domingo.

This species has been obtained at Loc. 267, C. A. S., horizons R and M - N; Loc. 306, near Usiacuri village, and Loc. 325, C. A. S., lower in the section; Loc. 351, C. A. S., near Punta Pua. Its vertical range is, therefore, almost throughout the Tuberá group.

48. *Calliostoma olssoni* Maury

Calliostoma (Eutrochus) olssoni MAURY, Bull. Am. Pal. vol. 10, 1925, p. 399, pl. 43, figs. 6, 14; Upper Miocene, Trinidad Island.

This elegant little shell has been obtained from various localities in the Colombian Miocene, as at Loc. 266, C. A. S., Arroyo Juan de Acosta; Loc. 299, C. A. S., near Baranoa; Loc. 306, C. A. S., Usiacuri village, etc. Its vertical range is confined to the upper part of the Tuberá group.

49. *Calliostoma tropica* Anderson, new species

Plate 16, figures 6, 7

Shell small, conical; height of holotype 17 mm., width 15.5 mm., finely beaded, abruptly truncate below; spire sharply conical, sloping evenly to the basal border with which it forms an angle of about 80 degrees; whorls 7 to 8 in number, sculptured with 6 to 8 finely beaded threads, crossed by lines of growth; sutures marked only by a slight depression at the border of the preceding whorl; base flattened, marked by 8 to 10 flat revolving threads, also beaded, but wider than the spiral threads on the upper slope; aperture ovate in outline; umbilicus closed. The species is characterized by its high conical spire and regular even slope, and also by its abruptly flattened base and finely beaded ornamentation. It is closely related to *Calliostoma derbyi* Maury from the Lower Miocene of Brazil.

Holotype: No. 4168, Mus. Calif. Acad. Sci., from Loc. 267, horizon M - N, Tuberá mountain, Colombia; Miocene.

50. *Oliva cylindrica* Sowerby

Oliva cylindrica SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 45; Miocene, Santo Domingo.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 67, pl. 10, figs. 14, 14a; Zone G, Rio Gurabo, Santo Domingo.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 335, pl. 23, figs. 2, 3; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 88, pl. 7, fig. 1; Gatun Stage.

Oliva gatunensis TOULA, Jahrb. der K. K. Geol. Reichs., 1909, Bd. 58, p. 702, pl. 25, fig. 12; Gatun formation, Canal Zone, Panama.

Cossmann seems to have given the first adequate description of this species in 1913 but it is not at present available. Maury has given two good figures, upon which much reliance is placed.

Good examples were obtained at Loc. 299, C. A. S., three miles southwest of Baranoa, and at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group.

51. *Oliva sayana* Ravenel

Oliva sayana RAVENEL, Cat., 1834, p. 19.—MAZYCK, Nautilus, vol. 28, 1915, p. 139.

Oliva sayana var. *immortua* BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 69, 1917, p. 33, pl. 5, fig. 6; Miocene, near Cartagena, Colombia.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 261, pl. 7, figs. 6, 7; Gatun Stage, Costa Rica.

This species and variety were obtained at Loc. 267, C. A. S., horizon R, at Tuberá village, near the top of the Tuberá group of the Colombian Miocene.

52. *Oliva brevispira* Gabb

Oliva brevispira GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 215; Miocene, Santo Domingo.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 232, pl. 10, figs. 16, 17; Loc. as above.—PILSBRY, Proc. Acad. Nat. Sci., Phila., vol. 73, 1921, p. 335, pl. 23, fig. 4 (Type); Miocene, Santo Domingo.

This species has been obtained at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, and at Loc. 325-A, near Cibarco, about the middle of the same group. Its range is at least from the basal beds to the middle of the Tuberá group of the Colombian Miocene.

53. *Oliva tuberaënsis* Anderson, new species

Plate 17, figures 2, 3

Shell large, thick, robust in form, spire high and acuminate; height of holotype 87 mm., width 37 mm., height of aperture 65 mm., thickness of shell at outer lip 5 mm.; suture clean and incised; aperture expanding gradually toward the anterior end, narrowed at the top into a cleft; outer lip smooth, simple and gently arcuate; inner border of aperture slightly calloused, a little depressed near the middle, and bearing oblique ridges below.

Holotype: No. 4172; *paratype*: No. 4174, Mus. Calif. Acad. Sci., from Loc. 267-R of Tuberá group; *paratype*: No. 4173, Mus. Calif. Acad. Sci., from Loc. 267-C, C. A. S., Tuberá group, Colombia; Miocene.

This species resembles most nearly *O. couvana* Maury from the Springvale group of the Miocene of Trinidad, but it has a larger, thicker and relatively heavier shell, and more ovate outline. The external calluses are wider, and the plications are more pronounced, as judged by Maury's figures. Our species differs from *O. proavia* Pilsbry & Johnson in a somewhat similar manner, not forgetting Maury's comparison.

This shell is fairly abundant in horizon R of the Tuberá group, and it was obtained also at horizon M - N, at Loc. 267, C. A. S., and very probably it will be found at intervening horizons.

54. *Marginella ballista* Dall

Marginella ballista DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, p. 47, pl. 4, fig. 6; Miocene, Tampa Silex beds, Florida.

This Floridan species has not before been cited from the Miocene of the Caribbean region, although beds equivalent in age and ecologic conditions probably exist at many points therein. The form and surface features of our shell are too nearly like those figured and described by Dall to warrant any other determination of it.

Dall has also described a varietal form of the same which he compares to *M. incrassata* Nelson, with which our species was

for a time tentatively identified. Its identity with the Floridan form seems to be supported by the possession of four oblique plications, as well as by the thickened outer lip and low spire. A single example of this species was found at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, in the Tuberá group.

55. *Marginella christinelladæ* Maury

Marginella christinelladæ MAURY, Bull. Am. Pal., vol. 5, 1917, p. 234, pl. 11, fig. 6; Zone B, Miocene, Rio Gurabo, Santo Domingo.

More than a dozen good examples of this species were obtained at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, and it was also found at horizon R, at Tuberá village, and therefore at the middle and near the top of the Tuberá group.

56. *Marginella coniformis* Sowerby

Marginella coniformis SOWERBY, Quart. Jour. Geol. Soc., Lond., vol. 6, 1928, 1849, p. 42; Miocene, Santo Domingo.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 288, pl. 17, fig. 2; Miocene, Trinidad Island.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 348, pl. 24, fig. 12; Gatun formation, Canal Zone.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 234, pl. 11, figs. 5, 5a; Miocene, Santo Domingo.

This species was obtained at the Spillway of the Canal in 1914, and since then at Loc. 267, C. A. S., horizon P of the Tuberá group, on the north slope of Tuberá mountain at a horizon believed to be the equivalent of the Gatun formation.

57. *Mitra dariensis* Brown & Pilsbry

Mitra dariensis BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 346, pl. 24, fig. 9; Gatun formation, Canal Zone.—OLSSON, Bull. Am. Pal. vol. 9, 1922, p. 273, pl. 6, fig. 25; Gatun Stage, Canal Zone.

Several good specimens of this species were obtained at the Spillway of the Canal in 1914, and since then it has been found at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group.

58. *Mitra longa* Gabb

Mitra longa GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 219.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 346, pl. 24, fig. 11.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 238, pl. 11, figs. 11, 11a; Miocene, Santo Domingo.—PILSBRY, Proc. Acad. Sci. Phila., vol. 73, 1921, p. 339, pl. 24, fig. 3 (Type); Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 273, pl. 6, fig. 10; Gatun Stage, Canal Zone.

Good examples of this species were found at Loc. 267, C. A. S., horizon M - N, and Loc. 351, C. A. S., near Punta Pua, in the latter case near the middle of the Tuberá group; it is believed to belong to both of these horizons. It occurs at Gatun, according to Olsson.

59. *Mitra mauryæ* Anderson, new species

Plate 8, figures 4, 5

Shell moderate in size, height of holotype, incomplete, 32 mm., width 10 mm., somewhat biconic in form; spire a little longer than the body whorl; suture slightly impressed; whorls rounded above and slightly convex below the shoulders; body whorl obversely pyriform; spire (incomplete) consisting of six whorls; sculpture cancellated; aperture long and narrow; canal long and straight; outer lip thin, not lirate within columella bearing four plications, the larger above, slightly more distant than the others; surface ornamented by 20 vertical ribs on the penultimate whorl, crossed by seven spiral threads, the two forming a cancellated sculpture very similar to that of *M. syra* Dall. This latter species, from the Silex beds of Tampa, Florida, is its nearest ally, though only one-half the length of the Colombian form, and with a somewhat more uniform taper to the apex.

Holotype: No. 4619, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon L, gray shales along the beach **one mile west of Puerto Colombia**; Miocene.

This species is known from only a single slightly imperfect specimen obtained from the gray shales along the beach a mile west of Puerto Colombia at Loc. 267-L, C. A. S. These shales underlie the Tuberá group, and probably form a part of the Las Perdices group.

60. *Scobinella morierei* (?) (Laville)

Plate 8, figures 6, 7

Euchilodon morierei (LAV.) in COSSMANN, Jour. Conch., vol. 61, 1913, p. 34, pl. 3, figs. 6, 7.

Scobinella morierei, OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 251, pl. 4, figs. 3, 4; Gatun Stage, Canal Zone.—MAURY, Bull. Am. Pal. vol. 10, 1925, p. 345, pl. 34, figs. 1, 8; Miocene, Trinidad Island.

A single but beautifully preserved example of this interesting species was found in the clay shales, underlying the Tuberá group a mile or more west of Puerto Colombia, associated with *Turris albida*, *Mitra mauryæ* (n. sp.), *Phalium dalli* (n. sp.), *Dentalium granadanum* (n. sp.), and others.

This example is larger and more robust than the figures given by Olsson, but otherwise is not easily distinguished from the form found in the Canal Zone. The ratio of length to width is less, being more nearly 3 : 1 in greatest width. The aperture is relatively wider, and the columellar plications are different, though the difference seems hardly to be specific in value. The species has not been found in higher beds in Colombia, as far as known.

Plesiotype: No. 4620, Mus. Calif. Acad. Sci., from Loc. 267-L, gray shales along the beach **one mile west of Puerto Colombia**; Miocene.

61. *Fasciolaria olssoni* Anderson, new species

Plate 8, figures 1, 2, 3

Shell large, thick, robust, biconic in form, smooth, showing lines of growth and faint spiral markings; length of holotype (without apex) 79 mm.; greatest width 57 mm.; paratype with six whorls; spire high, subconic, acuminate; upper surface of the whorls concave, terminating above in a clasping collar; suture distinct above the collar; shoulder of body whorl bearing five or more rounded tubercles, forming short broad ridges below, but none above the shoulder; aperture oval, terminating above in an acute angle, below in a narrow straight canal; inner margin of aperture evenly calloused, outer lip lirate within, margin unknown; umbilical chink

closed; pillar slightly twisted, bearing three rounded plications.

The largest example of this shell, although not complete, measures 113 mm. in length, and 71 mm. in width. The tubercles do not develop on the shoulders until about the fifth whorl, and become stronger on older shells.

Holotype: No. 4617; *paratype*: No. 4618 (C. A. S. type coll.), from Loc. 267-P, C. A. S., Tuberá mountain, Colombia; Miocene.

The surface of the older shells become much pitted by worm borings. This species is possibly the one listed and figured by Olsson as *F. gorgasiana* (Brown & Pilsbry).²⁶

This shell is fairly plentiful in the Tuberá group of the Colombian Miocene, and has been collected at Loc. 267, C. A. S., horizons P and R, and at other points which represent the horizon of the Gatun formation of the Canal Zone.

62. *Fasciolaria kempi* (Maury)

Siphonalia kempi MAURY, Bull. Am. Pal., vol. 4, 1910, p. 138, pl. 5, fig. 5; Chipola marls, Florida Miocene.

Fasciolaria kempi MAURY, Bull. Am. Pal., vol. 5, 1917, p. 245, pl. 12, fig. 4; Miocene, Santo Domingo.

This shell is not rare in the Tuberá group of the Colombian Miocene, and has been collected at Loc. 351, C. A. S., horizon near M - N, and at Loc. 305, C. A. S., near Turbaco.

63. *Fusus henekeni* (Sowerby)

Fusus henekeni SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 49; Miocene, Santo Domingo.—GUPPY, Geol. Mag. Lond., vol. 1, 1874, p. 439.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 524, pl. 28, fig. 6; Miocene, Haiti.—MAURY, Bull. Am. Pal., vol. 5, 1917 p. 242, pl. 12, fig. 1; Cercado de Mao, Miocene, Santo Domingo.

Two examples of this species were found at the village of Tuberá in the upper part of the Tuberá group, Loc. 267, C. A. S., horizon R. The rounded longitudinal ribs are pronounced on every whorl, from the nuclear to the body whorl, all of which are crossed by the strong spiral cords and lines described for this species.

²⁶ Olsson, A. A.—Bull. Am. Pal. vol. 9, 1922, p. 227, pl. 8, fig. 9; Gatun Stage, Canal Zone.

64. *Fusinus magdalenensis* Anderson, new species

Plate 15, figures 1, 2, 3

Shell large, height of holotype, incomplete, 110 mm., width 44 mm., fusiform, with high spire and long canal; spire consisting of nine whorls below the nuclear stage, the earlier ones only showing vertical ribs; spire sculptured by 10 to 15 strong revolving ridges, of two alternating ranks; body whorl containing 14 such ridges, only a few of which are of secondary rank; canal long and somewhat recurved near the terminus; pillar calloused throughout, and ornamented externally by spiral threads and cords alternating as above; spiral cords sharply ridged at the top.

This shell bears some resemblance to *F. henikeni* (Sow.), var. *veatchi* Maury, but it is larger, has fewer and coarser spiral cords, longer and more recurved canal, and a clearly more calloused pillar. It is not unlike a large and strongly marked species from the Gulf of California, namely, *Fusinus dupetitthouarsii* (Kiener), and it may well be a precursor of the same.

Holotype: No. 4651, Mus. Calif. Acad. Sci., from Loc. 267, horizon P, north slope of Tuberá mountain, Colombia; Miocene.

65. *Melongena propatulus* Anderson, new species

Plate 11, figures 1, 2

Shell large, heavy, height of holotype, incomplete, 108 mm., greatest width 91 mm., spire low and rounded, body pyriform or conical below the rounded shoulder, almost spineless, or having only few and inconspicuous spines on the shoulder of the whorl; holotype bearing two small, tubercle-like spines at the base, near aperture; whorls five; spire low but acuminate, rounded below the three nuclear whorls which form the apex; suture covered by an elevated collar; aperture ovate, notched behind, slightly notched on the shoulder; outer lip showing a disposition to form crenulations; inner lip broadly calloused; canal broad, as in *M. patulus*; pillar broad, and flattened below; surface marked by strong, flat spiral cords, crossed by

strong wavy lines of growth; spiral cords stronger near the base, one or more cords bearing a few small tubercles.

This shell has its closest ally in *M. patulus*, living on the Pacific coast and in the Gulf of California. Careful comparison has been made with good examples of this species in the collections of the California Academy of Sciences, and with *M. melongena* Linn. from the Caribbean region. It differs from both.

Holotype: No. 4632, Mus. Calif. Acad. Sci., from Loc. 267, horizon R, **Tuberá village, Colombia**; Miocene; embedded in sandstone near the top of the Tuberá group.

66. ***Solenosteira hasletti* Anderson, new species**

Plate 16, figures 7-A, 8

Shell not large, height of holotype 48 mm., width 30 mm., thickened, biconic in outline, spiney, not nodose; spire pagoda-like, with 5 or 6 whorls more or less concave above, the whorls culminating above in a collar clasping the preceding one; suture completely covered; surface marked by numerous revolving threads; on the upper slope four or five of these are heavier, with interspaces occupied by three to five finer threads, all of which, under the lens, appear beaded; lower slope ornamented in the same manner, but with more numerous heavy threads; periphery of each whorl supporting about seven strong spines that point upward and outward, buttressed by a low ridge beneath and above; aperture ovate, with narrow angle above forming a notch; outer lip slightly angulated, somewhat lirate within; inner lip symmetrically curved; pillar calloused near the aperture, recurved without; canal long and slightly recurved; umbilical area calloused, but showing a decided depression.

This shell is not unlike *Solenosteira alternata* (Nelson) from the Zorritos formation of Peru, but it is more strongly sculptured, and considerably more spinose in its mature form. It is found in many parts of the Tuberá group, and was obtained at Loc. 267, C. A. S., in horizon M - N, and horizon P. It is named in honor of Mr. Thomas D. Haslett.

Holotype: No. 4169, Mus. Calif. Acad. Sci., from Loc. 267—M-N, **Tuberá group, Colombia**; *paratype*: No. 4170, C. A. S., from Loc. 305, C. A. S., Turbaco, Colombia; *paratype*: No. 4171, Mus. Calif. Acad. Sci., from Loc. 304, C. A. S., from four miles east of Santa Rosa, Colombia, on ranch of Mrs. Gomez; Miocene.

67. ***Solenosteira santærosæ* Anderson, new species**

Plate 13, figures 7, 8, 9, 10

Shell of medium size, height of holotype, incomplete, 47 mm., width 35 mm., subconic in form, spinose, spiral sculpture pronounced; whorls five to seven below the nucleus; upper slope of whorls broad, bearing about seven strong ridges extending to the clasping sutural collar, sculptured by numerous revolving lines; lower slope abrupt and concave downward, crossed by numerous revolving lines or threads, among which appear a few stronger cords near the center of the lower surface; shoulders set with strong spines, sloping downward on the body whorl, but upward on the younger whorls; suture concealed by a clasping collar; pillar thick and short, reflexed; aperture ovate, narrowed above and at the canal; canal reflexed; umbilicus large; general appearance of the shell slouching and depressed.

Holotype: No. 4641, Mus. Calif. Acad. Sci., from Loc. 304, C. A. S., **4 miles east of Santa Rosa**; *paratype*: No. 4642, Mus. Calif. Acad. Sci., from Loc. 305, C. A. S., horizon P, near Turbaco, Colombia; Miocene.

This species is not infrequent in the Tuberá group of the Colombian Miocene. It has been obtained at Loc. 299-A, C. A. S., near the middle of the group, at Loc. 304, and at Loc. 305, C. A. S., lower down in the group, though not at the lowest horizon.

68. ***Phos tuberaensis* Anderson, new species**

Plate 9, figures 1, 2, 3

Shell of medium size, or large; spire high, somewhat turritid; height of holotype 50 mm., width of body whorl 26 mm., whorls seven in number, convex, ornamented chiefly

by spiral lines; two nuclear whorls smooth; next four whorls bearing low, rounded vertical ribs, and about 12 slightly raised spiral threads; upper slope of whorls concave; shoulders tuberculated; body whorl having 10 low ribs, crossed by spiral threads, heavier on base of shell; aperture oval, narrowed above; canal short, reflexed; outer lip sharp, lirate within; pillar bearing one anterior plication, not crusted.

Holotype: No. 4621, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, **on the north slope of Tuberá mountain, Colombia**; *paratype*: No. 4622, Mus. Calif. Acad. Sci., from Loc. 305, C. A. S., near Turbaco, Colombia; Miocene.

This shell resembles *Phos subsemicostatus* Brown & Pilsbry, but it is larger, has a more rugged sculpture and prominent tubercles.

It is not unlikely that the two species are nearly allied, though they are not identical.

This species is not rare in the Tuberá group, and the type was obtained at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain. It has been found also at Loc. 305, near Turbaco.

69. *Phos turbacoensis* Anderson, new species

Plate 15, figures 6, 7

Shell large, heavy, strongly sculptured; spire high, acuminate, heavily ribbed; whorls nine in number, concave above, with slightly elevated collar; costate below the shoulder, having 12 heavy ribs which are crossed by five or six heavy revolving threads below the shoulder; shoulder slightly tuberculate; body whorl irregularly ribbed, and ornamented with strong spiral threads with wide interspaces; interspaces sometimes containing intermediary lines; pillar short with one anterior plication; aperture arcuate-ovate; outer lip sharp, lirate within; pillar not calloused; canal short, reflexed; three nuclear whorls smooth; following six becoming gradually more strongly sculptured; height of holotype 55 mm., width of body whorl 27 mm., height of aperture 26 mm.

Holotype: No. 4654, Mus. Calif. Acad. Sci., from Loc. 305, C. A. S., near the village of Turbaco, Colombia; Miocene.

This shell resembles *Phos veatchi* Olsson, but it is larger, more strongly sculptured, and has a higher spire.

70. *Phos baranoanus* Anderson, new species

Plate 16, figures 4, 5

Shell rather large, conico-ovate, spire high, acuminate; whorls nine in number, convex; suture distinct, not impressed; two nuclear whorls smooth; next five whorls bearing small vertical ribs and four to eight spiral threads, producing a finely cancellated sculpture; last two whorls smooth, showing growth lines, but almost no spirals, except on the base; aperture arcuate-ovate, narrow above; outer lip sharp, lirate within; inner lip not crusted; pillar bearing a single anterior plication; canal reflexed. Height of the holotype is 51 mm., width 21.5 mm.

This shell is not rare in the Tuberá group, and has been obtained at Loc. 325-A, C. A. S., near Cibarco; Loc. 299, near Baranoa; Loc. 325, near Usiacuri; and at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain.

Holotype: No. 4657, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., horizon P, on the north slope of Tuberá mountain, Colombia; *paratype*: No. 4657-A, Mus. Calif. Acad. Sci., from Loc. 299, C. A. S., near Plott's well S. W. of Baranoa, Colombia; Miocene.

71. *Murex domingensis* Sowerby

Murex domingensis SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 49, pl. 10, fig. 5; Miocene, Santo Domingo.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 265, pl. 16, figs. 3, 4, 5, 6; Cercado de Mao, Miocene, Santo Domingo.

A single specimen of this shell was found at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, near the middle of the Tuberá group.

72. *Murex mississippiensis* Conrad

Murex mississippiensis CONRAD, Jour. Acad. Nat. Sci. Phila., vol. 1, 1848, p. 116, pl. 11, fig. 30.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1890, p. 130.—DALL, Bull. U. S. Nat. Mus. No. 90, 1915, p. 73, pl. 5, fig. 10; Tampa Silex beds, Miocene, Florida, etc.

A single example of this shell was obtained at Loc. 351, C. A. S., near Punta Pua, some 20 miles north of Cartagena, in the lower part of the Tuberá group.

73. *Typhis siphonifera* Dall

Plate 9, figure 8

Typhis siphonifera DALL, Bull., U. S. Nat. Mus., No. 90, 1915, p. 77, pl. 13, fig. 9; Tampa Silex beds, Tampa, Florida.

Typhis lingulifera DALL, var. *costaricensis* (?) OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 304, pl. 10, figs. 22, 29; Miocene, Costa Rica.

A single example of this interesting species was found at Loc. 325-A, C. A. S., near Cibarco, a few miles north of Usiacuri, and near the middle of the Tuberá group. A careful comparison of this well preserved specimen with Dall's figure and description leaves no room for doubt as to its determination, although the spire is slightly higher in our specimen. In this example the spire consists of seven whorls, including the two that form the nucleus. The specimen bears some resemblance to *T. lingulifera* Dall, but the latter has long and incurved spines where the varices meet the shoulder of the whorl, giving it a decidedly spiney appearance. The tubes arising from the shoulder in the interspaces between the spines form a distinguishing mark.

Plesiotype: No. 4625, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., near Cibarco, Colombia; Miocene.

74. *Distortrix simillima* (Sowerby)

Triton simillima SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 48; Miocene, Island of Haiti.

Persona simillima, GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 288, pl. 17, fig. 13; Miocene, Jamaica.

Distortio (Distortrix, Persona) gatunensis TOULA, Jahrb. d. K. K. Geol. Reichs., Bd. 58, 1909, p. 700, pl. 25, fig. 10; Gatun formation, Canal Zone.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 356, pl. 26, fig. 8; Gatun formation, Canal Zone.

Distortrix similima, MAURY, Bull. Am. Pal., vol. 5, 1917, p. 271, pl. 17, figs. 4, 5; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 305; Gatun Stage, Canal Zone.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 368; Miocene, Trinidad Island.

A good number of examples of this shell was obtained at the Spillway of the Canal in 1914, and since then it has been collected at Loc. 267, C. A. S., horizons P and R, and later at Loc. 325-A, near Cibarco, all of which represent a horizon near the middle, or in the upper part of the Tuberá group of the Colombian Miocene. It has not been found in the lowest horizon of the same.

75. *Cypræa henekeni* Sowerby

Cypræa henekeni SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 45, pl. 9, fig. 3; Miocene, Santo Domingo.—GABB, Am. Phil. Soc. Trans., vol. 15, 1873, p. 235.—GUPPY, Geol. Mag. Lond., vol. 1, 1874, p. 440.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 528.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 356.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 278, pl. 19, fig. 4; Miocene, Santo Domingo.

Two good examples of this species were obtained at Loc. 267, C. A. S., horizon M - N, at the west base of Tuberá mountain, in the lower part of the Tuberá group, and it has not yet been found higher in the group.

76. *Cypræa (Pustularia) gabbiana* Guppy

Plate 15, figures 4, 5

Pustularia nucleus, GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 236. (Not of Linnæus).

Cypræa pustulata, GUPPY, Geol. Mag. Lond., vol. 1, 1874, p. 440. (Not of Lamarck).

Cypræa gabbiana GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 528, pl. 29, fig. 10; Miocene, Santo Domingo.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1890, p. 165.

Cypræa (Pustularia) gabbiana, MAURY, Bull. Am. Pal., vol. 5, 1917, p. 280, pl. 19, fig. 12; Miocene, Santo Domingo.

A single well preserved example of this species was obtained at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group. The species is doubtless related to *C. pustularia* Lam., found in the Gulf of California, though it is narrower, and has more numerous transverse bars upon the bucal surface.

Plesiotype: No. 4653, Mus. Calif. Acad. Sci., from Loc. 351, C. A. S., horizon P, **near Punta Pua, Colombia**; Miocene

77. *Ovula* (*Neosimnia*) *puana* Anderson, new species

Plate 9, figures 9, 10

Shell small, length of holotype, broken, 20 mm., width 10 mm., biconic, smooth, bearing a subcentral, angular hump, but little elevated; aperture narrow, outer lip apparently simple, inner lip smooth and polished.

Holotype: No. 4626, Mus. Calif. Acad. Sci., from Loc. 351, C. A. S., **near Punta Pua, Colombia**, near the middle of the Tuberá group; Miocene.

This species is nearly related to *Ovula emarginata* Sowerby, from the Bay of Panama, but it differs in the elevation of the transverse hump.

Only a single specimen of this shell was obtained at Loc. 351, C. A. S., near Punta Pua, near the middle of the Tuberá group. It is herein included only for the purpose of making the record as complete as our material will permit.

78. *Malea ringens* (Swainson)

Plate 12, figures 1, 2, 3, 4, 5, 6

Cassis ringens SWAINSON, Blith. Catal. 1822, App. p. 4.—SOWERBY, Tankerv. Catal., 1825, App. 21.

Dolium ringens (SWAINS.) REEVE, Conch. Icon., vol. 5, 1849, pl. 4, fig. 5; living, Payta, Peru.

Malea ringens (SWAINS.) CONRAD, Pac. R. R. Repts., vol. 6, 1855, pt. 2, p. 72, pl. 5, fig. 22; Miocene, Gatun, Panama.

This species has not recently been listed from the Miocene of the Caribbean region, although Conrad reported it from

Panama Miocene beds as early as 1855. It was obtained by the writer at the Spillway of the Canal in 1914, and since then at a number of points in the Tuberá group of the Colombian Miocene. The identity of the fossil Colombian species with the living form from the Gulf of California is shown in the illustrations presented herein. It differs from the more common form, *Malea camura* Guppy, in having a higher spire, narrower and flatter revolving ribs, as is illustrated in Maury's figure of the latter, and a longer canal. The outer lip is not preserved in most of our fossil examples, but it appears to be represented in Toula's figure (pl. 30, fig. 7),²⁷ which agrees with some of our material from Gatun. In the Colombian Miocene it was obtained at the following localities:

Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain; Loc. 267, C. A. S., horizon R, Tuberá village, near top of group; Loc. 299, C. A. S., near Baranoa, near middle of the group; Loc. 305, C. A. S., southeast of Turbaco, Depart. de Bolivar; Loc. 351, C. A. S., near Punta Pua, near the middle of the group.

Its range is, therefore, through the upper part of the Tuberá group of the Colombian Miocene.

Plesiotype: No. 4633, Mus. Calif. Acad. Sci., recent shell from Bay of Panama; *plesiotype*: No. 4634, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, Tuberá mountain; *plesiotype*: No. 4635, Mus. Calif. Acad. Sci., from Loc. 299, C. A. S., horizon P, near Plott's well, S. W. of Baranoa, Colombia; Miocene.

79. *Cassis* (*Phalium*) *dalli* Anderson, new species

Plate 14, figures 10, 11, 12, 13

Shell small, height of holotype, young shell, 13 mm., width 11 mm., globose, coronated, with moderate or low spire; shell ornamented by fine spiral sculpture covering the entire body, crossed by lines of growth; aperture lunate, outer lip thin on the two examples found; canal short and recurved. The spire of this species consists of two smooth nuclear whorls, followed by three rapidly expanding whorls which are tabular above,

²⁷ Toula, F., Jahrb. d. K. K. Geol. Reichs., Bd. 61, 1911, p. 500.

angulated on the shoulder and convexly rounded below. The angles of the shoulder bear 12 to 13 flattened spines, elongated laterally, forming a distinct corona. This shell bears a certain resemblance to *P. moniliferum* (Guppy), but has a much finer sculpture, only a single row of tubercles, a lower spire, and is of smaller size.

Holotype: No. 4649; *paratype*: No. 4650, Mus. Calif. Acad. Sci., from Loc. 267-L, Las Perdices group underlying the Tuberá group a mile or more west of the Pier at Puerto Colombia; Miocene.

This species is represented by two examples from Loc. 267, C. A. S., horizon L, the gray shales of the Las Perdices group underlying the Tuberá group a mile or more west of the pier at Puerto Colombia. It has not been found at any higher horizon.

80. *Cassis (Phalium) moniliferum* Guppy

Cassis monilifera GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 17, fig. 8; Miocene, Jamaica.

Phalium moniliferum MAURY, Bull. Am. Pal., vol. 5, 1917, p. 274, pls. 18, figs. 4, 5; 19, fig. 1.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 307, pl. 12, fig. 11; Miocene.

This species was obtained at the Spillway of the Canal in 1914, but has not yet been certainly recognized in the Miocene of Colombia.

81. *Sconsia lævigata* (Sowerby)

Cassidaria lævigata SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 47, pl. 10, fig. 2.

Cassidaria sublævigata GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 287, pl. 27, fig. 9.

Cassidaria lævigata, GUPPY, Geol. Mag. Lond., vol. 1, 1874, p. 439.—Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 525.

Sconsia lævigata, BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 356.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 275, pl. 19, fig. 2; Cercado de Mao, Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 308.

This species was obtained at the Spillway of the Canal in 1914, and since then it has been collected at Loc. 267, C. A. S.,

horizon M - N, and at Loc. 351, C. A. S., near Punta Pua, in the latter case from near the middle of the Tuberá group of the Colombian Miocene. It has not been found at any higher horizon, as far as known.

82. *Ficus colombiana* Anderson, new species

Plate 13, figures 1, 2

Shell medium or large, pyriform, graceful in outline, sculpture decussated, suboval; height of holotype 41.5 mm., width 29 mm., height of paratype (incomplete) 59 mm., width 42 mm.; spire low, even in young shells; upper slope gentle, curving gracefully to the sides; nuclear whorls smooth; sculpture consisting of spiral cords widely spaced, with four or five intermediary lines, the central of which is stronger than the others; aperture wide, suboval; pillar slightly curved.

Holotype: No. 4636; *paratype*: No. 4637, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, **Tuberá mountain, Colombia**; Miocene.

The nearest ally of this species is *Ficus decussata* (Wood) from the Bay of Panama, Magdalena Bay and the Gulf of California. The principal difference in these species seems to be in the general outline and sculpture. The fossil species is more robust, has a shorter pillar and canal, and a much coarser sculpture. It differs from *F. carbacea* (Guppy), in its more rounded outline as well as in sculpture.

This species is represented by four good examples from Loc. 267, C. A. S., two of which came from horizon P, and two from horizon R, and accordingly from the middle and upper part of the Tuberá group. Other examples have been found at other localities in the middle part of the same group.

83. *Strombina chiriquiensis* Olsson

Strombina chiriquiensis OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 302, pl. 10, figs. 14, 24; Miocene, Costa Rica.

This species was found abundantly at Loc. 325-A, C. A. S., near Cibarco, near the middle of the Tuberá group of the Colombian Miocene.

84. *Dentalium granadanum* Anderson, new species

Plate 13, figure 3

Shell large, subcircular in section, gently curved, tapering very gradually; both ends complete when found, but subsequently broken; surface sculptured by 24 rounded but irregular longitudinal ribs, with no intermediate lines, the ribs continuing to the basal end of the shell; length of incomplete holotype not less than 55 mm.; greatest width 11 mm. When complete this shell was not less than 100 mm. in length. Its nearest ally seems to be one from Costa Rica described by Olsson as *D. uscarianum*, coming from the Uscari stage of the Miocene. Its resemblance, however, to *D. mississippiensis* Conrad²⁸ should be pointed out also.

Holotype: No. 4638, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon L, Las Perdices group, Puerto Colombia; Miocene.

A single example was obtained from the gray shales of the Las Perdices group below the Tuberá group, a mile west of Puerto Colombia.

85. *Serpulorbis papulosa* (Guppy)

Vermetus papulosa GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 292, pl. 17, fig. 3; Miocene, Santo Domingo.—Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 519; occurrence as above.

Serpulorbis papulosa (GUPPY) DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1585.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 291, pl. 22, fig. 10; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 317, pl. 12, fig. 1; Gatun Stage, Costa Rica.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 376, as above.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 377, etc.; Springvale horizon, Miocene, Trinidad Island.

Examples of this species have been obtained at Loc. 267, C. A. S., horizon M - N, and at Loc. 351, C. A. S., near Punta Pua, in the latter case from near the middle of the Tuberá group of the Colombian Miocene.

²⁸ Jour. Acad. Nat. Sci. Phila., vol. 1, 1848, p. 112, pl. 11, fig. 1.

86. *Serpulorbis granifera* (Say)

Serpula granifera SAY, Jour. Acad. Nat. Sci. Phila., vol. 4, 1824, p. 154, pl. 8, fig. 4.—Reprint, Bull. Am. Pal., vol. 1, 1896, p. 330, pl. 8, fig. 4; Miocene, Maryland.

Vermetus granifera, MARTIN, Md. Geol. Surv., 1904, p. 232, pl. 54, figs. 14, 15.

Serpulorbis granifera, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1892, p. 303.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 291, pl. 22, fig. 9; Miocene, Santo Domingo.

Examples of this species were obtained at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group.

87. *Petalconchus sculpturatus* H. C. Lea

Petalconchus sculpturatus LEA, Trans. Am. Phil. Soc., vol. 9, 1845, p. 233, pl. 34, fig. 3.

Petalconchus domingensis SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1849, p. 51, pl. 10, figs. 8, a, b, c.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 359; Gatun formation, Canal Zone.

Petalconchus sculpturatus, GABB, Trans. Am. Phil. Soc., vol. 25, 1875, p. 240; Miocene, Santo Domingo.—GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 32, 1876, p. 519.

Vermetus (Petalconchus) sculpturatus, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1892, p. 305.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 377; Miocene, Santo Domingo.

Petalconchus sculpturatus, OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 318, pl. 14, figs. 10, 15; Miocene, Canal Zone.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 378, pl. 41, figs. 2, 4, 7; Miocene, Trinidad Island.

This species occurs frequently in the Tuberá group of the Colombian Miocene. It has been obtained at Loc. 267, C. A. S., horizon M - N, and Loc. 351, C. A. S., near the middle of the group, and at Loc. 325-A, also near the middle of the group. It occurs at higher horizons as well, at other localities.

PELECYPODA

88. *Yoldia pisciformis* Brown & Pilsbry

Yoldia pisciformis BROWN & PILSBRY, Proc. Acad. Nat. Sci., Phila., vol. 17, 1917, p. 38, pl. 6, fig. 3; near Cartagena, Colombia.

This species is abundant about Tuberá mountain in the middle part of the Tuberá group, as at Loc. 267, C. A. S., horizons P and R, Tuberá group, and it has also been found at Loc. 304, C. A. S., four miles east of Santa Rosa, near the Colombian coast.

89. *Arca* (*Scapharca*) *patricia* Sowerby

Arca patricia SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1850, p. 52; Miocene, Santo Domingo.—WOODRING, Science, vol. 62, 1925, pp. 518, 519.

Although Gabb was very confident that he had found and identified Sowerby's species, *Arca patricia* with the living *Arca grandis* Brod. & Sowerby, it appears that his confidence was not well grounded in fact. W. P. Woodring has summarized the matter pertaining to the former species, including under it the following as synonymous:

Arca (*Anadara*) *grandis* (BROD. & SOW.), GABB, 1873.

Scapharca (*Argina*) *tolepiea* DALL, 1898.

Scapharca arthurpennelli MAURY, 1917.

Arca (*Argina*) *tolepiea* (DALL), PILSBRY, 1922, etc.

This species has been found in the Tuberá group of the Colombian Miocene at three different localities, and in fact seems to be quite common. In all of the examples the ribs number about 30, are slightly nodose, and the shell has the form and hinge characters described by Dall for his *Scapharca tolepiea*. It occurs abundantly at Loc. 267, C. A. S., in horizons M - N, and P, Tuberá mountain; Loc. 305, C. A. S., near Turbaco; and at Loc. 265, C. A. S., near Punta Paralillas, north of Monitos, on the Colombian coast. At the last point it was almost the only fossil found, but was sufficient to confirm the Miocene age of the strata, determined as such on other grounds.

90. *Arca* (*Noetia*) *macdonaldi* Dall

Arca (*Noetia*) *macdonaldi* DALL, Smiths. Misc. Coll., vol. 59, 1912, p. 9.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 366, pl. 25, figs. 4-7; Miocene, Costa Rica.

According to Dall this species is nearly related to *Arca trinitaria* Guppy, from the Miocene of Trinidad Island. Examples of it were found at Loc. 323, C. A. S., at the Spillway of the Canal in 1914, and subsequently at Loc. 267, C. A. S., horizons M - N, and P, of the Tuberá group, Tuberá mountain, and at Loc. 299, C. A. S., near Baranoa, Colombia. It is one of the abundant forms of this group.

91. *Arca* (*Scapharca*) *actinophora* Dall

Arca (*Scapharca*) *actinophora* DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 647, pl. 33, fig. 26; Monkey Hill, Canal Zone.

This species was collected at the Spillway of the Canal in 1914, and subsequently at two separate localities in the Colombian Miocene, as at Loc. 267, C. A. S., horizon P, Tuberá group, and at Loc. 351, C. A. S., near Punta Pua, some 20 miles north of Cartagena. At the latter locality three or four good examples were obtained which agree in all essentials with those of the Gatun formation.

92. *Arca* (*Scapharca*) *dariensis* Brown & Pilsbry

Arca (*Scapharca*) *dariensis* BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 362, pl. 22, fig. 10; Gatun formation, Canal Zone.

This species was found abundantly at the Spillway of the Canal in 1914, Loc. 323, C. A. S., and has since been found at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, in the middle of the Tuberá group. It appears to belong to the group of *Arca* (*Scaph.*) *inequilateralis* (Guppy) from the Miocene of Trinidad.

93. *Arca* (*Arca*) *occidentalis* Philippi

Arca (*Arca*) *occidentalis* PHILIPPI, Abbild. und Beschreib., vol. 3, 1847, p. 29, pl. 4, figs. 4, a, b; living, Caribbean Sea.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 327, pl. 29, fig. 3; Zone H, Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 353, pl. 22, fig. 1; Miocene, Costa Rica.—WOODRING, Mioc. Moll. Bowden, Jamaica, Carnegie Inst. Publ. No. 1925, p. 29, pl. 2, figs. 8, 9; Bowden beds, Jamaica.

This species has been obtained abundantly in the Bay of Cartagena and has been collected from the Miocene beds of Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena. It is a variable form and it would be surprising if it did not persist from the lower Miocene into the living fauna.

94. *Arca (Anadara) usiacurii* Anderson, new species

Plate 19, figure 6; plate 20, figure 6; plate 21, figure 4

Arca grandis BROD. & SOW., PILSBRY (in part), Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 404; Miocene, near Cartagena, Colombia.

Arca grandis ? *waringi* F. & H. K. HODSON, Bull. Am. Pal., vol. 13, 1927, p. 7, pl. 7, figs. 1, 4; Miocene, N. Venezuela.

Shell large, solid and heavy; nearly equivalve; length of holotype 105 mm., height 103 mm., thickness of valve from hinge plane to back 50 mm.; radial ribs 27 in number, slightly flattened, heavy, beaded on the anterior surface, and less strongly so elsewhere; intercostal spaces nearly equal in width to the ribs, marked by strong lines of growth; cardinal area broad, forming a nearly symmetrical triangle crossed by four to six grooves in fully grown specimens, sloping to the outer angles of the area, but not quite meeting on the median line; hinge heavy, set with about 48-58 thin, close-set, often branching teeth, which in the center are vertical, but toward the ends curve outwardly and are often broken by an oblique line; margin of shell strongly denticulate within, showing about 23 broad denticulations.

Holotype: No. 4158, Mus. Calif. Acad. Sci., from Loc. 306, C. A. S., at the **northeast border of the village of Usiacuri, Colombia**; *paratype*: No. 4159, Mus. Calif. Acad. Sci., from Loc. 267 M - N, C. A. S., Tuberá group, Colombia; Miocene.

This species is even more nearly related to *Arca grandis* Brod. & Sow. than is the form figured by Pilsbry as such, and by Maury as *Arca patricia* Sowerby²⁰ for which the name *Arca patriarcha* is here proposed. A comparison of the hinges and cardinal areas clearly shows several marked differences. The branching of the cardinal teeth near the ends of the hinge in the Colombian species is a distinctive mark. Although Dr.

²⁰ Bull. Am. Pal. vol. 5, p. 337, pl. 27, fig. 1.

Pilsbry had in his collection nine specimens from the Colombian coast (p. 404) he seems not to have noted the points in which they doubtless differ from the Dominican species or from the form living at Panama and other Pacific points.

This species is found in many parts of the Colombian marine Miocene associated with other purely marine forms. The holotype was obtained from Loc. 306, at the northeast border of the village of Usiacuri, more than 1,000 feet above the base of the group, where it is very abundant. The paratype comes from the uppermost part of horizon M - N of the Tuberá group, though it is abundant in higher horizons, as P and Q, and in still higher beds near the village of Usiacuri.

95. *Arca (Anadara) patriarcha* Anderson, new name

Arca grandis BROD. & SOW., GABB, Trans. Amer. Phil. Soc., vol. 15, 1873, p. 253 (in part); Miocene, Santo Domingo.

Arca grandis BROD. & SOW., PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1922, p. 404, pl. 40, fig. 1; Miocene, Santo Domingo. Not *Arca grandis* BROD. & SOW.; living, Bay of Panama, etc.

Arca patricia SOWERBY, MAURY, Bull. Am. Pal., vol. 5, 1917, p. 337, pl. 27, fig. 1; Caimito, Rio Caña, Santo Domingo.

This species has not yet been correctly reported from Colombia, although it appears to be quite abundant in the Miocene of Santo Domingo. As shown by the figure supplied by Maury the cardinal teeth are not numerous, and are correspondingly very coarse. It lacks many of the details of form and dentition given for *Arca grandis* Brod. & Sow., and for *Arca (Anadara) usiacurii* Anderson.

96. *Arca (Scapharca) auriculata* Lamarck

Arca auriculata LAM., An. s. Vert., vol. 6, 1819, p. 43; living fauna.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 647; Miocene, Bowden, Jamaica.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 339, pl. 28, fig. 3; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 362, pl. 22, fig. 3; Miocene, Costa Rica.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 201, pl. 4, fig. 2; Miocene, Trinidad Island.

This species has been found living in the Bay of Cartagena, and fossil in the Tuberá group of the Colombian Miocene, as at Loc. 267, C. A. S., horizon M - N, the lowest member of

the group. A careful comparison of the fossil and living examples shows the fossil form well within the range of variation in the living shells.

97. *Arca* (*Scapharca*?) *veatchi* Olsson

Arca veatchi OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 361, pl. 23, figs. 1-3; Gatun Stage, Miocene, Costa Rica.

This species has been obtained from Loc. 267, C. A. S., horizon M - N of the Tuberá group of the Colombian Miocene. The species appears to be nearly related to, though not identical with *Arca patricia* Sowerby, as understood in this paper.

98. *Arca* (*Scapharca*) *medioamericana* (Olsson)

Arca medioamericana OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 360, pl. 23, figs. 4-6; Miocene, Costa Rica.

Olsson has described this species as a variety of *Arca golfoyaquensis* Maury, but the specific differences seem so evident, both as to form and ornamentation, that it should be regarded as distinct. The species seems more closely related to *Arca actinophora* Dall, while Maury's species seems to be nearer to *Arca dariensis* Brown & Pilsbry.

99. *Arca* (*Scapharca*) *inequilateralis* Guppy

Arca inequilateralis GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, p. 293, pl. 18, figs. 2, a, b; Miocene, Jamaica.

Barbatia (*Diluvarca*) *inequalateralis* WOODRING, Mioc. Moll. Bowden, Jam., Carnegie Inst. Publ. No. 366, 1925, p. 45, pl. 5, figs. 1-3; Miocene, Jamaica.

This species has been obtained from Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, from near the middle of the Tuberá group, and from Loc. 299-A, C. A. S., between Cibarco and Chorrera, Tuberá group, Colombian Miocene.

100. *Arca cacica* Olsson

Arca cacica OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 362, pl. 24, fig. 1; Miocene, Costa Rica.

This species occurs at Loc. 299, C. A. S., near Baranoa, Colombia, in the central part of the Tuberá group, Colombian Miocene.

101. *Arca (Scapharca) hispaniolana* Maury

Arca (Scapharca) hispaniolana MAURY, Bull. Am. Pal., vol. 5, 1917, p. 340, pl. 30, figs. 9, 10; Miocene, Santo Domingo.

A single specimen of this species was obtained from each of the following localities: Loc. 304, C. A. S., four miles east of Santa Rosa; Loc. 306, C. A. S., near Usiacuri; and Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, Colombia; all of them in the central part of the Tuberá group of the Miocene.

102. *Arca pittieri* Dall

Arca pittieri DALL, Smiths. Misc. Coll., vol. 59, 1912, pt. 2, p. 9; Miocene, Costa Rica.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 364, pl. 24, figs. 2-6; Gatun Stage, Miocene, Costa Rica.

This species has been obtained at Loc. 305, C. A. S., near Turbaco; Loc. 349, C. A. S., near Galapa; and Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena. The first two occurrences are at points low in the Tuberá group, though the last is probably near the top.

103. *Arca (Scapharca) lloydi* Olsson

Arca (Scapharca) lloydi OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 364, pl. 24 figs. 10-12; Gatun Stage, Miocene, Costa Rica.

This species was obtained at Loc. 323, C. A. S., at the Spillway of the Canal, in 1914; and since then at Loc. 267, C. A. S., horizon P; and Loc. 306, C. A. S., Usiacuri; and also at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena; all from the central part of the Tuberá group.

104. *Glycymeris jamaicensis* Dall

Glycymeris jamaicensis DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 608.—
WOODRING, Carnegie Inst. Wash., Publ. No. 366, 1925, p. 24, pl. 2,
figs. 1-3; Miocene, Bowden, Jamaica.

This species has been found abundantly at Loc. 267, C. A. S., horizon M - N, and at Loc. 351, C. A. S., horizon P, both of the Tuberá group of the Colombian Miocene.

105. *Glycymeris carbasina* (?) Brown & Pilsbry

Glycymeris carbasina BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63,
1911, p. 363, pl. 28, fig. 9; Gatun formation, Canal Zone.

This species has been doubtfully identified among the forms found in the lowest horizon of the Tuberá group. It appears to be related to the preceding from the Bowden beds of Jamaica.

106. *Glycymeris lloydsmithi* Brown & Pilsbry

Glycymeris lloydsmithi BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol.
69, 1917, p. 39, pl. 6, fig. 6; Miocene; near Cartagena, Colombia.

Several good examples of this species were obtained from Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group of the Colombian Miocene.

107. *Glycymeris lamyi* Dall

Plate 22, figures 7, 8

Glycymeris lamyi DALL, Bull. U. S. Nat. Mus., No. 90, 1915, p. 122, pl. 20,
figs. 11, 13; Tampa Silex beds, Tampa Bay, Fla., Lower Miocene.

Glycymeris canalis, OLSSON (in part, not BROWN & PILSBRY), Bull. Am. Pal.
vol. 9, 1922, p. 349, pl. 18, figs. 4, 5; Miocene, Costa Rica.

Plesiotype: No. 4670, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., near Cibarco, Colombia; Miocene.

Dall's description and figures are sufficiently clear to enable one to recognize the species with considerable confidence. He seems to have had, however, only the young or immature shells upon which to base his description. His figures are almost twice natural size.

With further growth the number of primary ribs increases, and at the same time riblets appear on some of them. Superficially this species resembles *G. trilobica* Brown & Pilsbry, but it is not only larger, but has a narrower, less expanded outline near the beaks, and intermediary riblets which are lacking in *G. trilobica*.

Several good examples of this species were obtained at Loc. 351, C. A. S., and at Loc. 325, C. A. S., all in the central part of the Tuberá group of the Colombian Miocene.

108. *Glycymeris usiacurii* Anderson, new species

Plate 22, figures 3, 4

Shell small, sub-circular, moderately inflated; beaks small, median, a little prominent; primary ribs 15 in number, rounded, widest in the central part of the shell, separated by a groove containing a single intermediary riblet; ligamental area small, almost obsolete; line of the cardinal teeth rounded, not angular, set with eight teeth on each side of the median line, with a few rudimentary teeth near the middle; height of holotype 24 mm., length 24 mm., depth of single valve 7 mm.

This species outwardly resembles *G. canalis* Brown & Pilsbry, but unlike it has intermediary riblets, and not so many cardinal teeth in the hinge.

This form has been found plentifully at Loc. 325, C. A. S., a mile east of the village of Usiacuri, and nearly 2,000 feet above the base of the Tuberá group, of the Colombian Miocene.

Holotype: No. 4668, Mus. Calif. Acad. Sci., from Loc. 325, C. A. S., horizon P, near the village of Usiacuri, Colombia; Miocene.

109. *Ostrea haitensis* Sowerby

Ostrea haitensis Sow., Quart. Jour. Geol. Soc. Lond., vol. 6, 1850, p. 53.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 346, pl. 31, figs. 1, 2; Zone D, Gurabo, Miocene, Santo Domingo.—HODSON, F., Bull. Am. Pal., vol. 13, 1927, p. 21, pl. 10, fig. 7, pl. 11, fig. 4, and pl. 12, fig. 4; Oligocene-Miocene, State of Falcon, western Venezuela.

Ostrea vespertina (?), JORDAN & HERTLEIN (not CONRAD), Proc. Calif. Acad. Sci., vol. 15, 1926, p. 428; California Pliocene.

March 29, 1929

Sowerby's species has some marked features of resemblance to *O. vespertina* Conrad (= *O. veatchi* Gabb) from the upper Tertiary of the California coast, though identity is not claimed. *Ostrea gatunensis* Brown & Pilsbry, and *O. costariensis* Olsson apparently belong to the same group, and at least may be regarded as analogous, if not identical forms.

Ostrea haitensis has been found at Loc. 266, C. A. S., San Juan Acosta Creek, horizon R, and Loc. 351, C. A. S., near Punta Pua.

110. *Ostrea megadon* Hanley

Ostrea megadon HANLEY, Proc. Zool. Soc. Lond., 1845, p. 106; living, west coast of Peru.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 1586; Miocene, Santo Domingo, and Jamaica.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 347, pl. 34, fig. 3; Miocene, Santo Domingo.

Ostrea cerrosensis GABB, Geol. Surv. Calif., Pal. vol. 2, 1869, p. 35, pl. 11, fig. 61; Cedros Island, Pliocene.

This species was found abundantly at Loc. 299, C. A. S., west of Usiacuri; Loc. 306, C. A. S., three miles south of Baranoa; Loc. 347, C. A. S., near Turbaco; all of which are below the middle of the Tuberá group of the Colombian Miocene.

In this group of oysters should probably also be included *Ostrea messor* Maury from the Miocene of Trinidad.³⁰

It is worthy of note that *O. megadon*, *O. haitensis*, and *O. vespertina* should be so often found associated in the same beds. The two former are found together in the lower Miocene of north Colombia, the first and last are found in the Pliocene beds of the California coast. *Ostrea vespertina* (= *O. veatchi* Gabb) occurs in the Pliocene of Cedros Island and in contemporaneous beds in the Imperial valley, California, and is reported as still living in the Gulf of California. *Ostrea megadon* occurs with the preceding on Cedros Island and in Pliocene beds of Ventura county, and is found living at Turtle Bay, Lower California.

³⁰ Bull. Am. Pal. vol. 10, 1925, p. 233, pl. 10, figs. 3, 4.

111. *Pecten (Amusium) mortoni* Ravenel

Pecten mortoni RAVENEL, Proc. Acad. Nat. Sci., Phila., vol. 2, 1844, p. 96; Miocene, South Carolina.—TUOMEY & HOLMES, Pliocene Foss, S. Carolina, 1857, p. 27, pl. 9, figs. 1, 2; pl. 10, figs. 1, 2.

Pecten (Amusium) mortoni, CLARK ET AL., Maryland Geol. Surv., 1904, p. 372, pl. 99, fig. 1; Miocene, Maryland.

Brown & Pilsbry have described two species of *Amusium* from the Gatun formation of the Canal Zone, either one, or both of which may represent this species. The differences pointed out by these authors between *P. mortoni* Rav., and *P. (Amusium) luna* Brown & Pilsbry seem unimportant. Examples obtained from the Spillway of the Canal, 1914, and afterward from the Tuberá group, horizon M - N, are very similar, though the Colombian forms agree better with the characters of *P. mortoni* than do those from Gatun. In our specimens the ears are not depressed below the plane of the valve. The external surface is smooth, or marked only by faint lines of growth, the diameter of the largest example is 143 mm., though larger specimens were seen. The angle of divergence in the dorso-lateral lines is near 123° - 125° , varying a little, as may be expected. The concentric growth lines nearly describe a circle, and the number of pairs of internal ribs is 22 to 24. The species is not rare in the Tuberá group of Colombia. The best examples were found at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group. It occurs also at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

112. *Pecten (Plagiectenium) demiurgus* Dall

Pecten comparilis GUPPY, Geol. Mag., vol. 1, 1874. (Not TUOMEY & HOLMES, 1855).

Pecten (Plagiectenium) demiurgus DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 718, pl. 26, fig. 3.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 237, pl. 14, fig. 5; pl. 16, fig. 6; Miocene, Trinidad Island.

According to Maury, the shell, when full grown, sometimes measures as much as 75 mm. in altitude, and a little more in width. Ours are not so large, though larger examples were seen at the locality from which they came. It is abundant at Loc. 267, C. A. S., horizon M - N, near the base of the

Tuberá group. The gravelly beds of this horizon did not permit the extraction of the larger specimens. The proportions maintain in all of them.

113. *Pecten pinulatus* Toula

Pecten pinulatus TOULA, Jahrb. der K. K. Geol. Reichs., vol. 61, 1911, p. 491
pl. 30, fig. 3; Miocene, Canal Zone.

According to Toula's description and statement, the shell resembles that of *Pecten cactaceus* Dall, from the younger Tertiary of Tehuantepec. Our examples show a decided resemblance to Dall's species in surface ornamentation, although they are not so large.

Two good examples were obtained from Loc. 267, C. A. S., horizon M - N, where it is not rare in the gravelly beds with the preceding.

114. *Pecten atlanticola* Anderson, new species

Plate 19, figures 3, 7

Shell small, nearly circular, or slightly oblique, appressed, left valve a little more convex than the right; ears long, subequal, the anterior right ear bearing six radial riblets, the others mostly smooth; radial ribs on the body of the shell 13 in number, rounded, with interspaces of nearly the same width as the ribs; ribs and interspaces crossed by distinct lines of growth; altitude of holotype 36 mm., length 40 mm., thickness 10.5 mm.

Holotype: No. 4661; *paratype*: No. 4661-A, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain, Colombia; Miocene.

There is a strong resemblance, and evident relationship between this species and *P. prævalidus* Jordan & Hertlein,³¹ from the Pliocene of Turtle Bay, Lower California.

Several good specimens of this species were obtained at Loc. 267, C. A. S., horizon P, north slope of Tuberá mountain. As far as known this species belongs near the middle of the

³¹ Proc. Calif. Acad. Sci., vol. 15, 1926, p. 435, pl. 29, figs. 2, 3.

Tuberá group of the Colombian Miocene, therefore near the Gatun horizon.

115. *Pecten (Euvola) bowdenensis* Dall

Pecten (Euvola) bowdenensis DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 713, pl. 29, fig. 1.—(?) BÖSE, Bol. Inst. Geol. Mex., No. 22, 1906, p. 27, pl. 1, figs. 8, 10.—WOODRING, Carnegie Inst. Wash., Publ. No. 266, 1925, p. 63, pl. 7, figs. 8, 9; Miocene, Bowden beds, Jamaica.

A single example of this shell was obtained from Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, from beds believed to be equivalent to the Gatun formation of the Canal Zone.

116. *Pecten macloskeyi* Anderson, new species

Plate 19, figures 4, 5

Shell small, height of holotype 25.5 mm., length 24 mm., basal part circular, equivalve, beaks high, the borders forming an angle below 90 degrees; ears long, the anterior right ear bearing four corrugated riblets, the others nearly smooth; surface ornamented by about 12 low, smoothly rounded ribs, with interspaces narrower than the ribs; ribs on left valve very low, though not absent; all ribs more distinct on the younger shells.

Holotype: No. 4662; *paratype*: No. 4663, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., **north slope of Tuberá mountain, Colombia; Miocene.**

This species is distinguishable from *P. atlanticola* by its smaller size, lower, more rounded ribs, narrower umbonal angle, and less circular outline.

Several good examples of this shell were obtained at Loc. 267, C. A. S., associated with *P. atlanticola*, from which it is readily separated. As far as known both mark the middle of the Tuberá group of the Colombian Miocene. It is named in honor of Mr. Downs McCloskey, whose active interest aided much in the study of the section and in the collections.

117. *Spondylus bostrychites* Guppy

Spondylus bifrons SOWERBY, Quart. Jour. Geol. Soc. Lond., vol. 6, 1850 (not of GOLDF. 1835); Miocene, S. Domingo.

Spondylus bostrychites GUPPY, Proc. Sci. Soc. Trinidad, 1867, p. 176.—GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 257.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1898, p. 758; 1903, p. 1586.—Bull. U. S. Nat. Mus., No. 90, 1915, p. 124, pl. 19, fig. 4; Silex beds, Fla.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 354.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 413; Miocene, Santo Domingo.

A number of examples of this species were obtained at Loc. 267, C. A. S., horizon M - N, along with many other heavy shelled littoral forms, as shown elsewhere.

118. *Spondylus gumanomocon* Brown & Pilsbry

Spondylus americanus GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 257 (not of Lamarck); Miocene, Santo Domingo.

Spondylus gumanomocon BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 64, 1912, p. 514.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 355.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 413, pl. 43, figs. 4, 5; Miocene, Santo Domingo.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 379, pl. 21, fig. 1; Miocene, Costa Rica.

Several examples of a *Spondylus* corresponding very closely to this form were obtained at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group. They were associated with the preceding form and other littoral species. The probability of their identity with the above species is very great.

119. *Anomia mamillaris* Anderson, new species

Plate 16, figures 9, 10

Shell small, thin, smooth, translucent, circular in outline, convex; surface undulating, showing lines of growth, scaly near the umbones; umbone prominent, not quite central, inclining forward; height of holotype 22 mm., length 23 mm., depth of single valve 8 mm.

Holotype: No. 4165; *paratypes*: No. 4166 and 4167, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., from horizon M - N, Tuberá group, Colombia; Miocene.

Several good examples of this shell were obtained at Loc. 267, C. A. S., in the lowest horizon M - N, of the Tuberá group.

120. *Crassatellites berryi* Spieker

Crassatellites berryi SPIEKER, Johns Hopkins Univ. Publ. Geol., No. 3, 1922, p. 131, pl. 7, figs. 9, 10; Lower Zorritos, Peru.

This species is abundant at Loc. 267, C. A. S., horizon R, Tuberá village, north Colombia. As far as known it belongs only to this horizon, though its place in the Miocene of Peru is somewhat lower.

121. *Crassatellites (Scambula) densus* Dall

Crassatellites (Scambula) densus DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1472, pl. 39, figs. 9-12; Oak Grove, Florida.

This species was found plentifully in the lowest horizon M - N, of the Tuberá group at Loc. 267, C. A. S., near the western foot of Tuberá mountain, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

122. *Venericardia brassica* Maury

Venericardia terryi, var. *brassica* MAURY, Bull. Am. Pal., vol. 10, 1925, p. 323, pl. 30, fig. 5; Miocene, Trinidad.

• Miss Maury has described this species as a variety of *V. terryi* Olsson, from the Miocene of Costa Rica, which it somewhat resembles.

In view of its larger size, more prominent ribs, exceeding those of the Costa Rican species, our samples are regarded as distinct from the latter, though identical with the Trinidad species. Three well-preserved specimens were found at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, Colombian Miocene.

123. *Venericardia trinidadensis* Maury

Venericardia trinidadensis MAURY, Bull. Am. Pal., vol. 10, 1925, p. 323, pl. 30 fig. 6; Miocene, Trinidad Island.

A single valve of a venericard identifiable with the above was obtained at Loc. 305, near Turbaco, from a central horizon in the Tuberá group. Its range is not known.

124. *Cardita (Carditamera) arata* (Conrad)

Plate 20, figures 4, 5

Cypricardia arata CONRAD, Foss. Sh. Ter. Form., 1832, p. 20, pl. 5, fig. 1; Miocene, North Carolina, etc.

Cardita (Carditamera) arata, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1413.—MAURY, Monog. Serv. Geol. e Min. Brazil, 1925, p. 271, pl. 15, fig. 15; Miocene, Para, Brazil.

The shell is of moderate size, length 31 mm., height 18 mm., thickness 16 mm.; elongated subquadrate, rounded before, and somewhat truncated behind; beaks near anterior end but not terminal, strongly incurved and proximate; dorsal margin straight, ventral margin slightly arcuate; ribs 15 in number, with a tendency to become scaly, or even beaded, showing wavy lines of growth.

Plesiotype: No. 4164, Mus. Calif. Acad. Sci., from Loc. 267-B, C. A. S., horizon M - N, **Tuberá group, Colombia**; Miocene.

This description is here introduced in support of the identification of Conrad's species in the Miocene of north Colombia. Maury has stated that the species is found in the Chipola marls, associated with *C. vaughani* Dall, and in the lower Miocene of Para, Brazil, there is a very similar form. *C. arata* is said to be a widely distributed and abundant form, to which *C. floridana* Conrad, from the Pliocene of Florida is regarded as a successor.

Several examples of this species were found at Loc. 267, C. A. S., horizon M - N, of the Tuberá group of the Colombian Miocene. A comparison with samples of Conrad's species from Florida shows the only essential difference to be in the slightly more beaded ornamentation of the ribs in the more recent form.

125. *Cardita (Glans) scabricostata* Guppy

Cardita scabricostata GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 293, pl. 18, fig. 10; Miocene, Jamaica.

Venericardia scabricostata, DALL (part), Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1428.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 362, pl. 33, fig. 1; Miocene, Santo Domingo.—WOODRING, Carnegie Inst. Wash., Publ. No. 266, 1925, p. 99, pl. 12, figs. 7-9; Miocene, Jamaica.

Although Dr. Woodring does not include Maury's form as coming within the range of Guppy's species, it appears that it should not be regarded as a distinct form, and that it should have at least a varietal rank there. We have several good examples from five different localities, all of which approach the form figured by Maury, more nearly than that of Woodring. It occurs at Loc. 267, C. A. S., horizons M - N, P, and R, Tuberá mountain; Loc. 306, near Usiacuri; Loc. 355, Murindo creek; and it was obtained at Loc. 323, C. A. S., at the Spillway of the Canal in 1914.

126. *Echinochama antiquata* Dall

Chama arcinella, GUPPY, Geol. Mag., vol. 1, 1874, p. 450 (not of Linnæus); Miocene, Bowden, Jamaica, and Santo Domingo.

Echinochama antiquata DALL, Trans. Wag. Fr. Inst. Sci., vol. 3 1903, p. 1404, pl. 54, fig. 9.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 390, pl. 28, fig. 8; Miocene, Costa Rica.

This species occurs abundantly at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group, and at Loc. 351, C. A. S., in the middle part of the group, near Punta Pua, 20 miles north of Cartagena.

127. *Chama scheibei* Anderson, new species

Plate 22, figures 1, 2

Shell of moderate size, very unequal valves; height of holotype 43 mm., length 37 mm.; left valve inflated, right valve nearly flat; left valve with strongly recurved beak, right valve with smaller beak, less recurved; surface bearing only obsolete spines, if any, and only on the posterior part of left valve; right valve ornamented with wavy lamellæ following lines of growth; anterior part and umbone of left valve somewhat

beaded. A faint depression extends from the beak near and parallel to the anterior margin.

A number of samples of this species were found at Loc. 267, C. A. S., horizon M - N, near the base of the Tuberá group, Colombian Miocene.

Named in honor of the late Dr. Robert Scheibe of the Comicion Cientifica Nacional, Bogota.

Holotype: No. 4667, Mus. Calif. Acad. Sci., from Loc. 267-B, C. A. S., horizon M - N, **Tuberá mountain, Colombia**; Miocene.

128. *Thyasira bisecta* (?) (Conrad)

Plate 21, figure 1

Venus bisecta CONRAD, Geol. U. S. Expl. Expd., 1849, p. 724, pl. 17, figs. 10, 10a; Miocene, Astoria, Oregon.

Cyprina bisecta CONRAD, Am. Jour. Conch., vol. 1, 1865, p. 153; locality as above.

Cryptodon bisecta, DALL, Proc. U. S. Nat. Mus., vol. 17, 1895, p. 713, pl. 26, figs. 2, 5; living, Alaskan coast and southward.

Thyasira bisecta, DALL, Prof. Ppr. U. S. Geol. Surv., No. 59, 1909, p. 118; Miocene, Astoria, Oregon.

According to Dall this species is found living on the Alaskan coast, in Puget Sound, and occurs in the Miocene of Oregon and perhaps of California. As no reference to its occurrence in the Caribbean region has been found, it seems well to record it here, even though doubtfully recognized. The species was found by K. D. White at Loc. 350, C. A. S., near Arboletes Bay in the upper Miocene beds of the Colombian coast.

Plesiotype: No. 4664, Mus. Calif. Acad. Sci., from loc. 350, C. A. S., **Canalete Point, north coast of Colombia**; Miocene.

129. *Diplodonta woodringi* Anderson, new species

Plate 22, figures 5, 6,

Shell small, circular in outline, suborbicular, moderately inflated in the umbonal area; anterior end more abruptly sloping than the rounded posterior; height of holotype 26 mm.,

length 25 mm., thickness 18 mm.; beaks somewhat central, recurved, prominent; lunule only faintly marked.

Holotype: No. 4669, Mus. Calif. Acad. Sci., from Loc. 325-A, C. A. S., near Cibarco, Colombia; Tuberá group, Miocene.

Two or three samples of this species were obtained, one from Loc. 325, C. A. S., and the other, the holotype, from Loc. 325-A, C. A. S., near Cibarco, about horizon P of the Tuberá group, not common.

This species is named in honor of Wendell P. Woodring, whose work in the Caribbean Miocene and later formations is deserving of highest praise.

130. *Erycina turbacoensis* Anderson, new species

Plate 22, figures 9, 10

Shell large, oval, depressed; length of holotype (incomplete) 46 mm., height 35 mm., thickness 12 mm.; length of paratype (cast) 59 mm., height 45 mm.; beaks subcentral, a little nearer the posterior end, low, curved forward; lunular area small, impressed; anterior dorsal margin nearly straight, anterior end produced, posterior shorter, rounded; surface smooth, ornamented only by indistinct lines of growth. The hinge on the right valve of paratype is distinct, showing normal character of *Erycina*.

In form and general characters this species resembles *Erycina fabulina* Dall, from the Oak Grove Miocene, but it is many times larger. The figure of *Semele sayi* Toulou³² resembles this species somewhat, but seems to have a more decided concentric sculpture.

This species was found at Loc. 305, C. A. S., near Turbaco, Colombia, in the lower part of the Tuberá group.

Holotype: No. 4671; *paratype*: No. 4672, Mus. Calif. Acad. Sci., from Loc. 305, C. A. S., near Turbaco, Colombia, in the lower part of the Tuberá group; Miocene.

³² Jahrb. der K. K. Geol. Reichs., 1909, Bd. 58, pl. 28.

131. *Cardium* (*Trachycardium*) *dominicense* Gabb

Cardium (*Trachycardium*) *dominicense* GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 250.—GABB, Jour. Acad. Nat. Sci. Phila., vol. 8, 1874, p. 344; Miocene, Costa Rica.—PILSBRY & BROWN, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 367; Gatun formation, Canal Zone.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 421, pl. 25, figs. 8, 9; Miocene, Santo Domingo.

A single good example of this shell was found by K. D. White in the Miocene beds of the Rio Canalete, near the mouth of the Quebrada Murindo, in the district of Arboletes Bay, Colombia.

132. *Cardium* (*Trachycardium*) *puebloense* Anderson,
new species

Plate 19, figures 1, 2

Shell of medium size, subquadrate, thick, equilateral, surface somewhat enamelled; length of holotype 40 mm., height 44 mm., thickness 36 mm.; umbones high and prominent, only slightly angulated behind; ribs 30 to 34 in number, nearly smooth, though showing lines of growth; margins smooth, denticulate within, the posterior margin slightly serrate. A peculiarity of the sculpture is the linear division of the rounded ribs, separated by V-shaped interspaces; the anterior 18 or 20 ribs are sometimes divided longitudinally by an elevated thread, the posterior 12 or 14 are so divided by a groove of equal strength; in either case the ribs are marked by V-shaped incremental lines. These lines are apparent even on very young shells. This species appears to be related to *C. lingua-leonis* of the Jamaican Miocene, as illustrated by Woodring.

Holotype: No. 4660, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon R, at the village of Tuberá, Colombia; Miocene.

The holotype was found at Loc. 267, C. A. S., horizon R, at the village of Tuberá.

133. *Cardium* (*Trachycardium*) *lingualeonis* Guppy

Cardium lingualeonis GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 293, pl. 18, fig. 7; Miocene, Jamaica.—GUPPY, Geol. Mag., vol. 1, 1874, p. 422; (Not GUPPY, vol. 32, 1876, p. 531).

Cardium (*Trachycardium*) *lingualeonis*, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1900, p. 1084; Miocene, Chipola river, Florida.—WOODRING, Carnegie Inst. Wash., Publ. No. 366, 1925, p. 136, pl. 18, figs. 12, 13; Miocene, Bowden, Jamaica.

This species occurs abundantly in the Tuberá group, having been obtained at the following places: Loc. 267, C. A. S., horizon M - N; Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena; in the latter of these places it occurs near the middle of the Tuberá group.

134. *Cardium* (*Lævicardium*) *gorgasi* Hanna

Cardium (*Lævicardium*) *dalli* TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1908, p. 722, pl. 27, fig. 6; Gatun formation, Miocene.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 367; (not *C. dalli* HEILPRIN, 1887).

Cardium gorgasi HANNA, Proc. Calif. Acad. Sci., vol. 13, 1924, p. 160; new name proposed for the species.

Two examples of this species, measuring respectively 53 mm. and 45 mm. in height, were obtained at Loc. 267, C. A. S., horizon M - N, near the base of Tuberá group, and another from Loc. 266, C. A. S., near the top of the same group. It differs from *C. (Lævicardium) serratum* Linnæus in both form and ornamentation, is larger and a thinner form in which radial ribbing is present, though not prominent; while in the living form the radial markings are faint. In the fossil form the dorsal margin is elevated into a sharp ridge, slightly arched near the hinge, and the posterior end is produced and narrowed, while the living form is here distinctly rounded.

135. *Cardium* (*Lævicardium*) *serratum* Linnæus

Cardium serratum LINNÆUS, Syst. Nat. 1758, ed. 19, p. 680.

Cardium (*Lævicardium*) *serratum*, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1900, p. 1110; Miocene, Bowden, Jamaica.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 367; Gatun formation, Canal Zone.—WOODRING, Carnegie Inst. Wash., Publ. No. 366, 1925, p. 145, pl. 19, figs. 14 to 16; Bowden, Jamaica.

This species has been found at Loc. 305, C. A. S., near Turbaco, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, north coast of Colombia, near middle of the Tuberá group. The species is still living in the Caribbean waters, and was collected in the Bay of Cartagena and neighboring points in 1914.

136. *Cardium* (*Lævicardium*) *venustum* Gabb

Cardium venustum GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 251; Miocene, Santo Domingo.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 213, pl. 36, fig. 9; as above.—PILSBRY, Proc. Acad. Nat. Sci., vol. 73, 1921, p. 421, pl. 25, figs. 2, 7; Miocene, Santo Domingo.

A good example of this shell was obtained at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group.

137. *Dosinia delicatissima* Brown & Pilsbry

Dosinia delicatissima BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 64, 1912, p. 516, pl. 26, fig. 1; Miocene, Gatun formation.

Dosinia (*Artemis*) *acetabulum* (CONRAD), TOULA (?), Jahrb. der K. K. Geol. Reichs., Bd. 58, 1908, p. 727, pl. 27, figs. 8, 8a.

Examples of this species were obtained at the Spillway of the Canal in 1914, and subsequently at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena. They are indistinguishable, and seem to conform satisfactorily to the figure and description of the species given by Brown & Pilsbry.

138. *Dosinia* (*Artemis*) *acetabulum* (?) (Conrad)

Artemis acetabulum CONRAD, Foss. Sh. Tert. Format., 1833, p. 20, pl. 6, fig. 1; Miocene, Maryland.

Dosinia acetabulum CONRAD, Foss. Med. Tert., 1838, p. 29, pl. 16, fig. 1.—WHITE., Monog. U. S. Geol. Surv., No. 24, 1894, p. 73, pl. 13, fig. 2.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 403; Miocene, Costa Rica.

Dosinia (*Artemis*) *acetabulum* (CONRAD), TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1908, p. 727, pl. 27, figs. 8, 8a; Gatun formation, Canal Zone, Panama.

A fossil species probably referable to the above was obtained at Loc. 267, C. A. S., horizon P, near the middle of the Tuberá group of the Colombian Miocene.

139. *Clementia (Clementia) dariena* (Conrad)

Meretrix dariena CONRAD, House Doc. 129, 1855, p. 18; Miocene, Isthmus of Panama.—Pac. R. R. Repts., vol. 5, 1856, p. 328, pl. 6, fig. 55; occurrence as above.

Clementia dariena, GABB, Jour. Acad. Nat. Sci. Phila., vol. 8, 1881, p. 344, pl. 44, figs. 16, 16a; Miocene, Santo Domingo.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1235, Sapote, Costa Rica.—TOULA, Jahrb. der K. K. Geol. Reichs., vol. 58, 1908, pp. 725-727, pl. 27, figs. 9, 10; Gatun formation, Canal Zone.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 371, pl. 28, fig. 1.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 404; Miocene, Costa Rica.—WOODRING, Prof. Ppr. U. S. Geol. Surv., No. 147-C, p. 34.

Good examples of this species were obtained at the Spillway of the Canal in 1914 and it has since been collected at many localities in north Colombia, as at Loc. 267, C. A. S., horizons M - N and P; Loc. 305, C. A. S., near Turbaco; Loc. 302, C. A. S., four miles south of San Andres; Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

140. *Cyclinella gatunensis* Dall

Cyclinella gatunensis DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1285, pl. 52, fig. 18; Miocene, Gatun, Panama.

Several good samples of this species were obtained from Loc. 323, C. A. S., at the Spillway of the Canal in 1914, and it has since been found at various places in north Colombia. It occurs at Loc. 267, C. A. S., horizon R, Tuberá village; Loc. 302, C. A. S., four miles south of San Andres, Dept. of Bolivar; upper horizon of the Miocene. As it has not hitherto been reported outside of the type locality its discovery in the Tuberá group is interesting.

141. *Cyclinella cyclica domingensis* Pilsbry & Johnson

Dosinia cyclica GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 582, pl. 26, figs. 15a, b; Miocene, Trinidad.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1285; probably Santo Domingo Miocene.

Cyclinella cyclica domingensis PILSBRY & JOHNSON, Proc. Acad. Nat. Sci., Phila., vol. 69, 1917, p. 200; Miocene, Santo Domingo.—PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 424, pl. 47, fig. 3; as above.

Three examples of this species were obtained at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group, Colombian Miocene.

142. *Antigona (Ventricola) blandiana* (Guppy)

Venus blandiana GUPPY, Proc. Sci. Soc. Trinidad, vol. 3, 1873, pp. 85-86, pl. 2, fig. 8.—Geol. Mag., vol. 1, 1874, p. 436, pl. 17, fig. 8; Miocene, Trinidad.

Antigona (Ventricola) blandiana, WOODRING, Carnegie Inst. Wash., Publ. No. 366, 1925, p. 157, pl. 21, figs. 5-9; Miocene, Bowden, Jamaica.

This species has been found in the Tuberá group at Loc. 267, C. A. S., horizons M - N and P, and at Loc. 351, C. A. S., near Punta Pua, north of Cartagena. The species is closely related to *Antigona fordi* Yates,³³ now living on the Pacific coast from Monterey Bay to Panama (Dall).

143. *Antigona caribbeana* Anderson

Antigona caribbeana ANDERSON, Proc. Calif. Acad. Sci., vol. 16, 1927, p. 90, pls. 2 and 3; Loc. 267, Horizon M - N, Tuberá group of Colombian Miocene.

This is perhaps the largest representative of the genus yet found in the Caribbean Tertiary deposits. It has commonly been regarded as the Miocene form of *Antigona multicosta* (Sowerby), but upon a careful comparison it can be easily distinguished by various characters, among which are the crenulations on the inner margin of the shell. It occurs plentifully in the basal beds of the Tuberá group.

144. *Callocardia (Agriopoma) gatunensis* Dall

Callocardia (Agriopoma) gatunensis DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1260, pl. 54, figs. 1, 15; Gatun formation, Panama.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 370; occurrence as above.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 407, pl. 32, fig. 1; Miocene, Costa Rica.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 298, pl. 27, figs. 5, 7; Miocene, Trinidad Island.

This species has been obtained at Loc. 267, C. A. S., horizon P, on the north slope of Tuberá mountain, and at Loc.

³³ Yates, Santa Barbara Nat. Hist. Soc. Bull. 2, p. 46.

351, C. A. S., near Punta Pua, 20 miles north of Cartagena. It occurs, therefore, near the middle of the Tuberá group.

145. *Pitaria (Lamelliconcha) circinata* (Born)

Venus circinata BORN, Test. Mus. Caes. Vind., 1778, p. 61, pl. 4, fig. 8; living in Caribbean waters.

Chione circinata, GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 250; Miocene, Santo Domingo.

Pitaria (Lamelliconcha) circinata, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1269; Gatun formation; Cumana, Venezuela, etc.—MAURY, Bull. Am. Pal., vol. 5, 1917, p. 379, pl. 37, fig. 1; Miocene, Santo Domingo. —Bull. Am. Pal., vol. 10, 1925, p. 301, pl. 27, figs. 12, 13; Miocene, Trinidad Island.

Pitar circinata, BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 370; Gatun formation, Canal Zone.

Pitaria circinata, OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 408, pl. 31, figs. 3, 9; Miocene, Costa Rica.

Numerous examples of this species were obtained from the Bay of Cartagena in 1914, and it has since been collected at Loc. 267, C. A. S., horizon R, at Tuberá village, and from Pliocene beds on the Caribbean coast of Colombia.

146. *Pitaria cercadica* Maury

Pitaria cercadica MAURY, Bull. Am. Pal., vol. 5, 1917, p. 380, pl. 37, fig. 10; Miocene, Santo Domingo.

This species has been obtained at Loc. 267, C. A. S., horizon M - N, and horizon R, of the Tuberá group, and should be found also in intervening strata. It is believed to be closely related to *Pitaria albida* Gray (?), now living in the Bay of Cartagena.

147. *Pitaria acutecostata* (Gabb)

Callista acutecostata GABB, Trans. Am. Phil. Soc., vol. 15, 1873, p. 250, Miocene.

Pitaria acuticostata, MAURY, Bull. Am. Pal., vol. 5, 1917, p. 380, pl. 37, fig. 2; Miocene, Santo Domingo.

Pitar (Lamelliconcha) acuticostatus PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 73, 1921, p. 422, pl. 47, fig. 10; occurrence as above.

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This species is found at Loc. 267, C. A. S., horizon R, Tuberá village. In size and form it approaches very near to *P. affinis* Sowerby, now living in neighboring waters.

148. *Tivela mactroides* (Born)

Venus mactroides BORN, Test. Mus. Caes. Vind., 1778.

Cytherea mactroides, REEVE, Conch. Icon., 1863, pl. 5, figs. 18, a, b, c; living fauna, Caribbean region.

Tivela mactroides, DALL, Proc. U. S. Nat. Mus., vol. 26, 1902, p. 367; occurrence as above.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 295, pl. 26, fig. 8; pl. 27, fig. 3; Miocene, Trinidad.

Numerous examples of this shell were obtained from the Bay of Cartagena and near by points in 1914, and it has since been found fossil at Loc. 325-A, C. A. S., near Cibarco, a little above the middle of the Tuberá group. Comparison with the living form shows no essential difference in the fossil.

149. *Macrocallista* (*Chionella*) *maculata* (Linnæus)

Venus maculata LINNÆUS, Syst. Nat. 1758, ed. 10, p. 680; living.

Macrocallista (*Chionella*) *maculata*, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1256; Chipola beds, Florida.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 406, pl. 31, figs. 6, 7; Miocene, Costa Rica.—MAURY, Bull. Am. Pal., vol. 10, 1925, p. 279, pl. 25, figs. 1, 4, 5; upper Miocene, Trinidad.

This species is found living in the Bay of Cartagena, and other Caribbean waters, and was found fossil at Loc. 267, C. A. S., horizon M - N, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, in the lower and central parts of the Tuberá group.

150. *Chione* (*Chamelea*) *nuciformis* (Heilprin)

Cytherea nuciformis HEILPRIN, Trans. Wag. Fr. Inst. Sci., vol. 1, 1887, p. 116, pl. 16, fig. 61; Pliocene, Florida.

Chione (*Chamelea*) *nuciformis*, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1300; Miocene, Tampa Bay, Florida.

This species has been obtained at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena, near the middle of the Tuberá group of the Colombian Miocene.

151. *Chione* (*Chione*) *walli* Guppy

Venus walli GUPPY, Quart. Jour. Geol. Soc. Lond., vol. 22, 1866, p. 581, pl. 26, fig. 16; Miocene, Trinidad.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, pp. 1291, 1587; Miocene, Trinidad, Bowden, Jamaica.—SPIEKER, Pal. Zorritos Format., Johns Hopkins Univ. Publ., Geol., No. 3, pp. 151, 154; Miocene, Peru.

Chione (*Chione*) *walli*, MAURY, Bull. Am. Pal., vol. 10, 1925, p. 311, pl. 28, figs. 2, 11, 15; Miocene, Trinidad.

A species of *Chione*, probably referable to the above, was found at Loc. 267, C. A. S., horizons M - N and R of the Tuberá group. Its occurrence at both the bottom and top of the group makes it likely that it will be found also at intervening horizons.

152. *Chione* (*Lirophora*) *mactropsis* (Conrad)

Gratelupia (?) *mactropsis* CONRAD, House Doc. 129, 1855, p. 18; Isthmus of Panama.—Pac. R. R. Repts., vol. 5, 1856, p. 328, pl. 6, fig. 54; Miocene, Isthmus of Panama.

Chione (*Lirophora*) *mactropsis*, DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1294; Gatun formation, Panama.

Chione mactropsis, OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 417, pl. 30, figs. 7, 8; Gatun formation, Canal Zone.

This species occurs abundantly in the Miocene at Gatun, and at Loc. 267, C. A. S., horizon M - N, Tuberá group, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

153. *Chione* (*Lirophora*) *latilirata* (Conrad)

Venus latilirata CONRAD, Proc. Acad. Nat. Sci. Phila., vol. 1, 1841, p. 28.—CONRAD, Foss. Sh. Med. Tert., 1845, p. 68, pl. 38, fig. 3; Miocene.

Chione (*Lirophora*) *latilirata*, MEEK, Checkl. Mio. Foss. Am., 1864, pp. 9, 30.—DALL, Trans. Wag. Fr. Inst. Sci., vol. 3, 1903, p. 1298, pl. 42, fig. 3; Miocene.

Chione (*Lirophora*) *cartagenensis* F. & H. K. HODSON, Bull. Am. Pal., vol. 13, p. 63, pl. 31, fig. 4; pl. 35, fig. 6; Miocene, Colombia.

This species occurs at Loc. 267, C. A. S., horizon M - N of the Tuberá group, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

154. *Chione atlantica* Anderson, new species

Plate 23, figures 5, 6

Shell of moderate size, subtriangular in outline; length of holotype 61 mm., height 51 mm., thickness 41 mm.; dorsal margin nearly straight, ventral margin broadly rounded, posterior angulated; beaks prominent; anterior slope short, projecting, forming angle with the ventral border; surface ornamented by raised concentric lamellæ, fluted on the ventral side as in *Chione guppyana* Gabb, as described by Pilsbry.³⁴

The lunule is relatively large and bordered by a sharply defined groove; escutcheon moderately wide, bordered by ridges; inner border of shell finely crenulated.

Holotype: No. 4676, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, **Tuberá mountain, Colombia**; Miocene.

This species is nearly related to *Chione guppyana*, but it differs from Gabb's species in being more nearly triangular in outline, straighter on the dorsal border, more prominent in front, and in lacking concentric lamellæ along the ventral margin.

This species has been obtained at Loc. 267, C. A. S., horizon P, where it was associated with *Pitaria circinata*, *Antigona caribbeana*, and *Clementia dariena*.

155. *Tellina costaricana* Olsson

Tellina costaricana OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 423, pl. 26, figs. 6, 9; Gatun Stage, Costa Rica.

This species is abundant at Loc. 267, C. A. S., horizons P and R, and also in the basal horizon M-N, of the Tuberá group of the Colombian Miocene.

156. *Tellina dariena* Conrad

Tellina dariena CONRAD, House Doc., 129, 1855, p. 18.—CONRAD, Pac. R. R. Repts., vol. 5, 1856, p. 328, pl. 6, fig. 53; Isthmus of Darien, Miocene.—GABB, Jour. Acad. Nat. Sci. Phila., vol. 8, 1881, p. 343, pl. 44, fig. 13.—BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 368.—OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 424, pl. 26, fig. 3; Gatun, Canal Zone.

³⁴ Proc. Acad. Nat. Sci. Phila. vol. 73, 1921, p. 423.

Tellina rowlandi TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1908, p. 728, pl. 28, fig. 11; Gatun, Canal Zone.

This species has been found at Loc. 304, C. A. S., near Santa Rosa, and at Loc. 351, C. A. S., near Punta Pua, 20 miles north of Cartagena.

157. *Tellina gatunensis* (Toula)

Macoma (*Tellina*) *gatunensis* TOULA, Jahrb. der K. K. Geol. Reichs., Bd. 58, 1908, p. 729, text figure 10, a; Gatun, Canal Zone.

Tellina gatunensis, BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 63, 1911, p. 368; Gatun formation, Canal Zone.

Macoma gatunensis, OLSSON, Bull. Am. Pal., vol. 9, 1922, p. 429; Gatun Stage, Costa Rica.

Several good examples of this species have been obtained from various localities in north Colombia, as at Loc. 267, C. A. S., horizons M - N and P; Loc. 303, C. A. S., about three miles north of San Andres, Dept. of Bolivar, etc. One of these examples exposes the hinge clearly, showing that it is a typical *Tellina* of the group *T. radiata* Linnæus, found in the West Indies. The occurrence of this species with many others of the Tuberá group at San Andres is to be specially noted.

158. *Tellina* (*Eurytellina*) *æquiterminata* (?)

Brown & Pilsbry

Plate 23, figure 4

Tellina æquiterminata BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., vol. 64, 1912, p. 517, pl. 26, fig. 5; Gatun formation, Canal Zone.

A rather large *Tellina* was found at Loc. 304, C. A. S., four miles east of Santa Rosa, which in outline and general characters conforms to the above species, though in size it agrees more nearly with *T. radiata* Linnæus. The left valve is somewhat more concave in longisection than in *T. radiata*, and the sculpture is different. The surface is marked by undulations and finer concentric lines, which at the posterior end become lamellar. The growth lines form an obtuse angle on crossing the posterior angle of the shell. Approximate length 60 mm., height 35 mm., thickness 11 mm.

Plesiotype: No. 4675, Mus. Calif. Acad. Sci., from Loc. 304, C. A. S., horizon P, four miles east of Santa Rosa, Colombia; Miocene.

159. *Tellina* (*Eurytellina*) *æquicincta* Spieker

Tellina (*Eurytellina*) *æquicincta* SPIEKER, Paleont. Zorritos Form., Peru; Johns Hopkins Univ. Publ. Geol., No. 3, 1922, p. 158, pl. 10, fig. 3; Zorritos group, Miocene, Peru.

Two specimens of a *Tellina* were obtained at the village of Tuberá, Loc. 267, C. A. S., horizon R, which seem to be referable to this species. In form and sculpture the resemblance is striking, and there appears to be no reason for doubting their identity.

160. *Tellina* (*Eurytellina*) *cibaoica* (?) Maury

Tellina (*Eurytellina*) *cibaoica* MAURY, Bull. Am. Pal., vol. 5, 1917, p. 387, pl. 38, fig. 10; Zone H, Rio Caña, Santo Domingo.

A single specimen of *Tellina* was found at Loc. 304, C. A. S., east of Santa Rosa, that conforms to Maury's description and figure of this Dominican form. It seems to be related to *Tellina striata* Chemnitz, from the West Indian province.

161. *Tellina protolyra* Anderson, new species

Plate 21, figures 2, 3

Shell small, height of holotype 25 mm., length 34 mm., thickness 12 mm., partly elliptical, truncated behind, rounded in front, more broadly rounded on the ventral margin; peaks posterior to a central position, high, pointing forward, excavated in front forming a sort of lunule-like depression; inequivalve, the right valve being flatter and slightly concave in advance of the umbonal angle; posterior dorsal margin nearly straight, formed by a narrow carina-like ridge on either side, giving the posterior dorsal slope a groove-like character; surface ornamented by acute, elevated, concentric threads with relatively wide, concavely open interspaces,

almost smooth, or faintly striated, and evenly spaced from beak to ventral margin.

This species is clearly related to *Tellina lyra* Hanley which is found living at Tumbez, Peru, which is probably a successor to our species. The examples of this species were all found at Loc. 267, C. A. S., horizon M - N, of the Tuberá group of the Colombian Miocene.

Holotype: No. 4163, Mus. Calif. Acad. Sci., from Loc. 267-B, C. A. S., horizon M - N, of the Tuberá group, Colombia; Miocene.

162. *Semele claytoni* (?) Maury

Semele claytoni MAURY, Bull. Am. Pal., vol. 5, 1917, p. 391, pl. 35, fig. 9; Miocene, Cercado de Mao, Santo Domingo.

A single specimen of *Semele* that seems referable to this Dominican species was found at Loc. 351, C. A. S., near Punta Pua, Colombia.

163. *Semele sardonica* Dall

Semele sardonica DALL, Bull. U. S. Nat. Mus., No. 90, p. 154, pl. 20, figs. 4 and 7; Miocene, Tampa Bay, Florida.

A single well preserved valve of a *Semele* was obtained at Loc. 351, C. A. S., near Punta Pua, Colombia, that is identifiable with Dall's species from the lower Miocene of Florida.

164. *Psammosolen sancti-dominici* Maury

Psammosolen sancti-dominici MAURY, Bull. Am. Pal., vol. 5, 1917, p. 392, pl. 37, fig. 13; Miocene, Cercado de Mao, Santo Domingo.

A single determinable specimen of *Psammosolen* was obtained at Loc. 351, C. A. S., near Punta Pua, that seems to be referable to Maury's Dominican species.

165. *Mactra* (*Mulinia* ?) *atlanticola* Anderson, new species

Plate 20, figures 1, 2, 3

Shell of moderate size, length of holotype 50 mm., height 43 mm., thickness 33 mm.; robust, ventricose, smooth,

ornamented only by concentric growth lines; beaks rather high, nearly central or a little in advance of central, curved slightly forward; anterior and posterior slopes straight, anterior end broadly rounded, posterior end more narrowly rounded; lunular area flattened, or somewhat concave under the beaks; shell not gaping behind, not angulated, but for the most part regularly rounded.

Holotype: No. 4161; *paratype*: No. 4162, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon M - N, of the Tuberá group, at the west end of Tuberá mountain, Colombia; Miocene.

The nearest known related species is *Mulinia densata* Conrad, in the upper Miocene of California, although it has a heavier and more solid shell than the Colombian examples here described.

Several good specimens of this species were found at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, at the west foot of Tuberá mountain. There is an outward resemblance to other Caribbean forms, but the hinge reveals its generic class.

166. *Mactrella* (Harvella) *elegans* (Sowerby)

Plate 21, figures 5, 6

Mactra elegans SOWERBY, Tank'v. Catal. Append. (116), p. ii, pl. (i), fig. 3; living at Panama and Pacific points.—CARPENTER, Rept. Brit. Ass'n. Adv. Sci., 1857, pp. 174, 227; living at Panama and other points.

Harvella pacifica CONRAD, Amer. Jour. Conch., vol. 3, 1867, p. 192; vol. 5, p. 108, pl. 12, fig. 2; living at Panama.

Mactrella (*Harvella*) *elegans*, DALL, Nautilus, vol. 8, 1894.

Conrad described *H. pacifica* as living at Panama, and attempted to distinguish his supposed new form from *H. elegans* (Sowerby) to which he refers as a Floridan species. Dall discredits Conrad's name, on the ground of lacking sufficient basis, at least until further evidence was found. Although Sowerby's original description has not been seen, in view of the known variability in such forms, it appears unlikely that Conrad's discrimination is sound. Two species so similar are not likely to occur together.

A comparison of the fossil species with representatives of the living form does not permit of any distinction that can be maintained in either form, size or sculpture.

A number of good samples of this species was found at Loc. 267, C. A. S., horizon M - N, of the Tuberá group, at the west foot of Tuberá mountain.

Plesiotypes: Nos. 4665 and 4666, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon M - N, of the Tuberá group, at the west foot of Tuberá mountain, Colombia; Miocene.

167. *Labiosa* (*Ræta*) *gibbosa* (Gabb)

Ræta gibbosa GABB, Amer. Jour. Conch., vol. 5, 1870, p. 30; Miocene, Peru.—GABB, Jour. Acad. Nat. Sci. Phila., vol. 8, 1874, p. 264, pl. 35, figs. 8, 8a.

Two well preserved samples of this species were obtained at Loc. 267, C. A. S., horizon R, Tuberá village, near the top of the Tuberá group, and three of the same form were found at Loc. 351, C. A. S., near Punta Pua, some 20 miles north of Cartagena. In referring these to Gabb's Peruvian species identification is based entirely upon his description and figures, as no comparative material was available from his locality.

168. *Labiosa* (*Ræta*) *gardneræ* Spieker

Labiosa (*Ræta*) *gardneræ* SPIEKER, Johns Hopkins Univ. Publ. Geol., No. 3, 1922, p. 168, pl. 10, fig. 10; upper part of Zorritos, Miocene, Peru.

A number of samples of this species was obtained from different parts of the Tuberá group at the following points:

Loc. 267, C. A. S., horizon R, Tuberá group; Loc. 299, C. A. S., central part of the Tuberá group; Loc. 325, C. A. S., central part of the Tuberá group; Loc. 325-A, C. A. S., middle part of the Tuberá group.

The species seems, therefore, to range from the central to the upper part of the Tuberá group.

169. *Labiosa* (*Ræta*) *hasletti* Anderson, new species

Plate 23, figures 2, 3

Shell large, inflated in front, somewhat produced and narrow behind; height of holotype 47 mm., length, incomplete,

61 mm., thickness 39 mm.; test thin, somewhat nacreous; beaks a little in advance of central, prominent and rather heavy; posterior slope slightly concave; shell thickest a little in advance and above the median plane; umbonal ridges inclined forward; surface marked by strong concentric ridges, some of which are not continuous.

This species is related to *L. (Ræta) gibbosa*, but is thicker, less produced in front and relatively more produced behind. It has not the straight posterior slope of Gabb's species.

This species is abundant at Loc. 267, C. A. S., in horizon P, on the north slope of Tuberá mountain. It has been named in honor of Mr. Thomas D. Haslett, by whose courtesy and aid the investigation of this district was greatly facilitated.

Holotype: No. 4674, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon P, **Tuberá mountain, Colombia**; Miocene.

170. *Periploma caribana* Anderson, new species

Plate 23, figure 1

Shell sub-nacreous, large, compressed, nearly circular in outline, and nearly equivalve; beaks relatively small, umbones not prominent, sub-central, crossed by an acute transverse ridge extending downward from the beaks; anterior end short, broadly rounded, quite closed; posterior slope straight at first, then rounded, narrower than in front; surface marked by undulating concentric ridges and lines of growth, the former stronger near the ventral margins; hinge not well known; height of holotype 61 mm., length 71 mm., thickness 27 mm.

This shell is apparently rare, though three specimens were found in the upper part of the Tuberá group. Its nearest relative is probably *Periploma peralta* (Conrad) from the St. Mary's formation at Cave Point, Maryland. Its distinctness from this species is very evident upon a careful comparison and study of Conrad's description and figure.

The three samples obtained were found at Loc. 267, C. A. S., at horizon R, Tuberá village.

Holotype: No. 4673, Mus. Calif. Acad. Sci., from Loc. 267, C. A. S., horizon R, **Tuberá village, Colombia**; Miocene.

FORAMINIFERA

From the lowest horizon, M - N, of the Tuberá group a number of micro-organisms were obtained from the matrix of the larger mollusks which were submitted for determination to Mr. C. C. Church. His notes regarding these forms are as follows:

"The few Foraminifera obtained from this material are, for the most part, so poorly preserved that specific determination is practically impossible, although genera can be distinguished easily, and in the case of the large, well preserved *Amphistegina* the specific characters are quite clear.

"171. *Amphistegina lessoni* D'Orbigny

"This species is known from the Tertiary to the Recent and is a common form in the Miocene and Pliocene of the Atlantic coastal plain of the United States. It is known to exist at the present time in the tropical areas of the Atlantic, Pacific and Indian oceans, and is commonest in water of less than 30 fathoms in depth, but it also occurs at greater depths.

"The species is highly variable in form, and ranges from a thin complanate disc to a subspherical test. In the younger and smaller individuals the umbilical area is a pronounced boss of clear shell material.

"In the larger and flattened forms the umbilicus is not so prominent. The largest form noted is more than one millimeter wide and very thin. The material associated with the Foraminifera shows every indication of having been deposited in shallow water.

"172. *Quinqueloculina auberiana* (?) D'Orbigny

"There is not much doubt that this form belongs to the species here assigned, but the fact that there are no very complete, or well preserved specimens makes it necessary to indicate a possible error.

"173. *Lituotuba lituiformis* (?) (H. B. Brady)

"This genus is represented by a single individual which is not very well preserved. The name of the genus is after Cushman's latest classification, but it is best known as *Trochammina* PARKER & JONES."

Besides the Foraminifera listed above there are a few other microscopic forms which deserve some mention. Among these are three species, and perhaps as many genera, of Ostracoda; also several small or embryonic forms of bivalves and gastropods.

CALIFORNIA ACADEMY OF SCIENCES LOCALITIES

Following is a brief description of the fossil localities referred to in the preceding text, notes, tables, etc., and are of record in the Museum of the California Academy of Sciences:

- Locality 265 (C.A.S.). Punta Piedras, three miles south of Paso Nuevo, Department of Bolivar, Colombia; marine Miocene.
- Locality 266 (C.A.S.). Quebrada San Juan de Acosta, near Puerto Colombia, Department of Atlantico, Colombia; marine Miocene.
- Locality 266-A (C.A.S.). Falls in small creek, two miles west of Tuberá mountain, Department of Atlantico, Colombia; marine Miocene.
- Locality 267 (C.A.S.). Tuberá mountain, Dept. of Atlantico, Colombia; M - N, 1.5 miles west of Tuberá village; P, 1 mile west of Tuberá village; R, Tuberá village, near summit of the mountain.
- Locality 296 (C.A.S.). East border of Usiacuri village, Dept. of Atlantico, Colombia; 2000 feet above the base of the Tuberá group.
- Locality 297 (C.A.S.). Three miles west of Barranquilla, Colombia; coralline limestone, Pliocene.
- Locality 298 (C.A.S.). One mile east of Usiacuri village, Dept. of Atlantico, Colombia; top of Tuberá group, Miocene.
- Locality 299 (C.A.S.). Three miles southwest of Baranoa, Dept. of Atlantico, Colombia; west flank of the Usiacuri anticline, near well of Wm. Plotts; Miocene.
- Locality 302 (C.A.S.). Ranch of Sr. Banda, four miles south of San Andres, Dept. of Bolivar, Colombia; Tuberá group, Miocene.
- Locality 303 (C.A.S.). Two miles east of San Andres, Dept. of Bolivar, Colombia; Miocene.
- Locality 304 (C.A.S.). Four miles east of Santa Rosa, Ranch of Sra. Gomez, Dept. of Bolivar, Colombia; Tuberá group, Miocene.
- Locality 305 (C.A.S.). Near Turbaco, 16 miles east of Cartagena, Dept. of Bolivar, Colombia; Tuberá group, Miocene.
- Locality 306 (C.A.S.). Usiacuri village, Dept. of Atlantico, Colombia; middle of Tuberá group, Miocene.
- Locality 323 (C.A.S.). Gatun Locks, Gatun, Canal Zone, Panama, Miocene.
- Locality 325-A (C.A.S.). Between Chorrera and Cibarco, Dept. of Atlantico, Colombia; near middle of Tuberá group, on west flank of Usiacuri anticline, Miocene.
- Locality 325-B (C.A.S.). East of Usiacuri village (same as Loc. 306), Dept. of Atlantico, Colombia, Miocene.
- Locality 347 (C.A.S.). La Popa Hill, near Cartagena, Colombia; top of Miocene.
- Locality 348 (C.A.S.). Village of Turbaco, Dept. of Bolivar, Colombia, Pliocene.

- Locality 349 (C.A.S.). From four to five miles southwest of Barranquilla Colombia; top of the Miocene.
- Locality 350 (C.A.S.). Arboletes Bay, Dept. of Bolivar, Colombia; upper Miocene.
- Locality 351 (C.A.S.). Near Punta Pua, 20 miles north of Cartagena, Dept. of Bolivar, Colombia; Tuberá group, Miocene.
- Locality 353 (C.A.S.). Near Cospique Hill, Cartagena harbor, Colombia.
- Locality 354 (C.A.S.). Quebrada de Murindo, above Pedro de Claver, Dept. of Bolivar, Colombia; Tuberá group, Miocene.
- Locality 355 (C.A.S.). Quebrada de Murindo, 30 miles west of Monteria, Dept. of Bolivar, Colombia; Tuberá group, Miocene.
- Locality 356 (C.A.S.). Pedro de Claver, Quebrada de Murindo, 30 miles west of Monteria, Dept. of Bolivar, Colombia, Miocene.
- Locality 357 (C.A.S.). Emory Wood Company's camp, Rio Canalete, west of Monteria, Dept. of Bolivar, Colombia; Miocene.

PLATE 8

- Fig. 1. *Fasciolaria olssoni* Anderson, new species. Holotype No. 4617 (C. A. S. type coll.), Loc. 267 C. A. S., horizon P, Tuberá group; Tuberá mountain; p. 131.
- Figs. 2, 3. *Fasciolaria olssoni* Anderson, new species. Paratype No. 4618 (C. A. S. type coll.), front and rear views; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 131.
- Figs. 4, 5. *Mitra mauryæ* Anderson, new species. Holotype No. 4619 (C. A. S. type coll.), front and rear views; Loc. 267, C. A. S., horizon L, Las Perdices group, one mile west of Puerto Colombia; p. 130.
- Figs. 6, 7. *Scobinella morierei* (?) (Laville). Plesiotype No. 4620 (C. A. S. type coll.), front and rear views, Loc. 267, C. A. S., horizon L, Las Perdices group, one mile west of Puerto Colombia; p. 131.



PLATE 9

- Figs. 1, 2. *Phos tuberaënsis* Anderson, new species. Holotype No. 4621 (C. A. S. type coll.), rear and front views; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 135.
- Fig. 3. *Phos tuberaënsis* Anderson, new species. Paratype No. 4622 (C. A. S. type coll.), Loc. 305, C. A. S., near Turbaco, 14 miles east of Cartagena; p. 135.
- Figs. 4, 5. *Conus tubercola* Anderson, new species. Holotype No. 4623 (C. A. S. type coll.), front and top views; Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 112.
- Figs. 6, 7. *Conus crenospiratus* Anderson, new species. Holotype No. 4624 (C. A. S. type coll.), front and top views, X2; Loc. 351, C. A. S., horizon P, Tuberá group, near Punta Pua, 20 miles north of Cartagena; p. 112.
- Fig. 8. *Typhis siphonifera* Dall. Plesiotype No. 4625 (C. A. S. type coll.), X2; Loc. 325-A, C. A. S., horizon P, Tuberá group, near Cibarco, a few miles north of Usiacuri, Colombia; p. 138.
- Figs. 9, 10. *Oxula (Neosimnia) puana* Anderson, new species. Holotype No. 4626 (C. A. S. type coll.), front and rear views, X2; Loc. 351, C. A. S., horizon P, Tuberá group, near Punta Pua, north of Cartagena; p. 140.



PLATE 10

- Figs. 1, 2. *Cancellaria scheibei* Anderson, new species. Holotype No. 4627 (C. A. S. type coll.), front and rear views; Loc. 306, C. A. S., horizon P, Tuberá group, near Usiacuri village; p. 114.
- Figs. 3, 4. *Cancellaria scheibei* Anderson, new species. Paratype No. 4528 (C. A. S. type coll.); 3, front view, 4, slightly rotated to show plaits; Loc. 304, C. A. S., horizon P, Tuberá group, near Santa Rosa; p. 114.
- Figs. 5, 6. *Cancellaria hettneri* Anderson, new species. Holotype No. 4629 (C. A. S. type coll.), rear and front views; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 114.
- Figs. 7, 8. *Cancellaria karsteni* Anderson, new species. Holotype No. 4630 (C. A. S. type coll.), rear and front views; Loc. 305, C. A. S., horizon P, Tuberá group, near Turbaco, 14 miles east of Cartagena; p. 114.
- Fig. 9. *Cancellaria karsteni* Anderson, new species. Paratype No. 4631 (C. A. S. type coll.), view showing columellar plaits; Loc. 267, C. A. S., horizon P, Tuberá group, Tuberá mountain; p. 114.



PLATE 11

Figs. 1, 2. *Melongena tropatulus* Anderson, new species. Holotype No. 4632 (C. A. S. type coll.), rear and front views; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 133.



PLATE 12

- Figs. 1, 2. *Malea ringens* (Swainson). Plesiotype No. 4633 (C. A. S. type coll.), rear and front views of mature shell, Bay of Panama, Hemphill collection; recent; p. 140.
- Figs. 3, 4. *Malea ringens* (Swainson). Plesiotype No. 4634 (C. A. S. type coll.), front and side views of mature shell, outer lip missing; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 140.
- Figs. 5, 6. *Malea ringens* (Swainson). Plesiotype No. 4635 (C. A. S. type coll.), rear and front views of younger shell; Loc. 299, C. A. S., near Plotts' well, southwest of Baranoa, Colombia; p. 140.

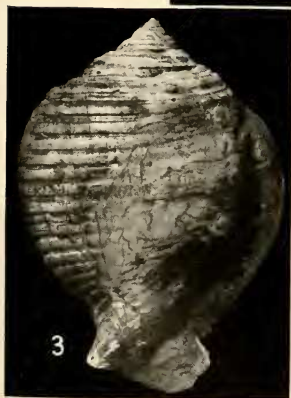


PLATE 13

- Fig. 1. *Ficus (Pyrula) colombiana* Anderson, new species. Holotype No. 4636 (C. A. S. type coll.), aperture view; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 143.
- Fig. 2. *Ficus (Pyrula) colombiana* Anderson, new species. Paratype No. 4637 (C. A. S. type coll.), Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 143.
- Fig. 3. *Dentalium granadanum* Anderson, new species. Holotype No. 4638 (C. A. S. type coll.), broken shell, parts joined with clay, outer layer of shell missing in part; Loc. 267, C. A. S., horizon L, Las Perdices group, west of Puerto Colombia; p. 144.
- Figs. 4, 5. *Crucitulum (Disfolæa) gatunense* (Toula). Plesiotype No. 4639 (C. A. S. type coll.); 4, side view showing granular surface, X2; 5, interior showing cup, X2; Loc. 323, C. A. S., Spillway of Gatun Locks, Canal Zone; p. 121.
- Fig. 6. *Crucitulum (Disfolæa) gatunense* (Toula). Plesiotype No. 4640 (C. A. S. type coll.), side view of smaller shell, X2; Loc. 323, as above; p. 121.
- Figs. 7, 8. *Solenosteira santarosæ* Anderson, new species. Holotype No. 4641 (C. A. S. type coll.), rear and front views; Loc. 304, C. A. S., horizon P, Tuberá group, four miles east of Santa Rosa, Colombia; p. 135.
- Figs. 9, 10. *Solenosteira santarosæ* Anderson, new species. Paratype No. 4642 (C. A. S. type coll.), rear and front views; Loc. 305, C. A. S., horizon P, Tuberá group; p. 135.

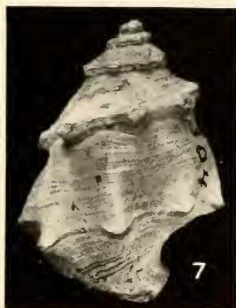
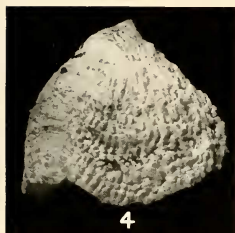


PLATE 14

- Figs. 1, 2. *Cancellaria cibarcola* Anderson, new species. Holotype No. 4643 (C. A. S. type coll.); 1, front view; 2, rotated to show columellar plaits; Loc. 325-A, C. A. S., horizon P, near Cibarco, Tuberá group; p. 116.
- Fig. 3. *Cancellaria cibarcola* Anderson, new species. Paratype No. 4644 (C. A. S. type coll.), rear view of smaller shell; Loc. 325-A, as above; p. 116.
- Figs. 4, 5. *Cancellaria codazzii* Anderson, new species. Holotype No. 4645 (C. A. S. type coll.), rear and front views; Loc. 325-A, C. A. S., horizon P, Tuberá group, near Cibarco, north of Usiacuri village; p. 116.
- Fig. 6. *Cancellaria codazzii* Anderson, new species. Paratype No. 4646 (C. A. S. type coll.), broken shell showing columellar plaits; Loc. 325-A; p. 116.
- Fig. 7. *Cancellaria codazzii* Anderson, new species. Paratype No. 4647 (C. A. S. type coll.), young shell, X2; Loc. 325-A, as above; p. 116.
- Figs. 8, 9. *Polinices prolactea* Anderson, new species. Holotype No. 4648 (C. A. S. type coll.), rear and front views; Loc. 267, C. A. S., horizon L, Las Perdices group, west of Puerto Colombia; p. 124.
- Figs. 10, 11. *Cassis (Phalium) dalli* Anderson, new species. Holotype No. 4649 (C. A. S. type coll.), rear and front views, X2; Loc. 267, C. A. S., horizon L, Las Perdices group, west of Puerto Colombia; p. 141.
- Figs. 12, 13. *Cassis (Phalium) dalli* Anderson, new species. Paratype No. 4650 (C. A. S. type coll.), rear and front views, X2; Loc. 267, C. A. S., horizon L, Las Perdices group, as above; p. 141.



PLATE 15

- Figs. 1, 2. *Fusinus magdalenensis* Anderson, new species. Holotype No. 4651 (C. A. S. type coll.), front and rear views of incomplete shell; Loc. 267, C. A. S., horizon P, Tuberá group, Tuberá mountain; p. 133.
- Fig. 3. *Fusinus magdalenensis* Anderson. Paratype No. 4652 (C. A. S. type coll.), fragment showing character of long canal; Loc. 267, C. A. S., as above; p. 133.
- Figs. 4, 5. *Cypræa (Pustularia) gabbiana* Guppy. Plesiotype No. 4653 (C. A. S. type coll.), upper and basal views, X2; Loc. 351, C. A. S., horizon P, Tuberá group, near Punta Pua, north of Cartagena, Colombia; p. 139.
- Figs. 6, 7. *Phos turbacoënsis* Anderson, new species. Holotype No. 4654 (C. A. S. type coll.), front and rear views; Loc. 305, C. A. S., horizon P, Tuberá group, near Turbaco, 14 miles east of Cartagena; p. 136.



PLATE 16

- Figs. 1, 2. *Amphullaria tuberculata* Anderson, new species. Holotype No. 4655 (C. A. S. type coll.), front and basal views of mature shell; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 125.
- Fig. 3. *Amphullaria tuberculata* Anderson, new species. Paratype, No. 4656 (C. A. S. type coll.), rear view of young shell; Loc. 267, C. A. S., as above; p. 125.
- Fig. 4. *Phos baranoanus* Anderson, new species. Holotype No. 4657 (C. A. S. type coll.), front view; Loc. 299, C. A. S., horizon P, Tuberá group, near Plotts' well, southwest of Baranoa, Colombia; p. 137.
- Fig. 5. *Phos baranoanus* Anderson, new species. Paratype No. 4657a (C. A. S. type coll.), aperture view showing lirate interior; Loc. 299, C. A. S., as above; p. 137.
- Figs. 6, 7. *Calliostoma trofica* Anderson, new species. Holotype No. 4168 (C. A. S. type coll.), side and basal views; Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 126.
- Figs. 7-A, 8. *Solenosteira hasletti* Anderson. Holotype No. 4169 (C. A. S. type coll.), rear and front views; Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 134.
- Fig. 9. *Anomia mamillaris* Anderson. Holotype No. 4165 (C. A. S. type coll.), Loc. 267, C. A. S., horizon M - N, Tuberá group, as above; p. 158.
- Fig. 10. *Anomia mamillaris* Anderson. Paratype No. 4167 (C. A. S. type coll.), Loc. as above; p. 158.

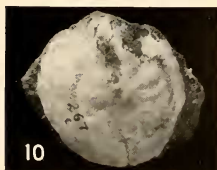


PLATE 17

- Fig. 1. *Turritella fredeai* Hodson. Plesiotype 4175 (C. A. S. type coll.), example from basal beds of Tuberá group near Punta Pua, 20 miles north of Cartagena; p. 119.
- Figs. 2, 3. *Oliva tuberaënsis* Anderson. Holotype No. 4172 (C. A. S. type coll.), front and rear views; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 128.
- Fig. 4. *Turritella altilira* Conrad. Plesiotype No. 4658 (C. A. S. type coll.), Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 118.
- Fig. 5. *Turritella altilira* Conrad. Plesiotype No. 4659 (C. A. S. type coll.), Loc. 267, C. A. S., horizon M - N, as above; p. 118.

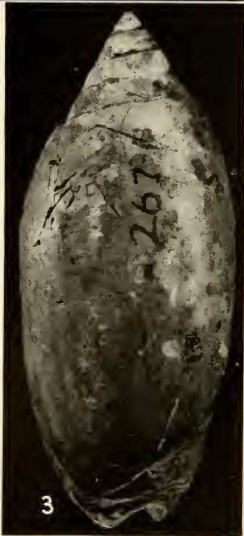


PLATE 18

Figs. 1, 2. *Arca* (*Anadara*) *grandis* Broderip & Sowerby. Plesiotype No. 4160 (C. A. S. type coll.), interior and exterior views of right valve. Example from Bay of Panama, F. M. Anderson, collector.

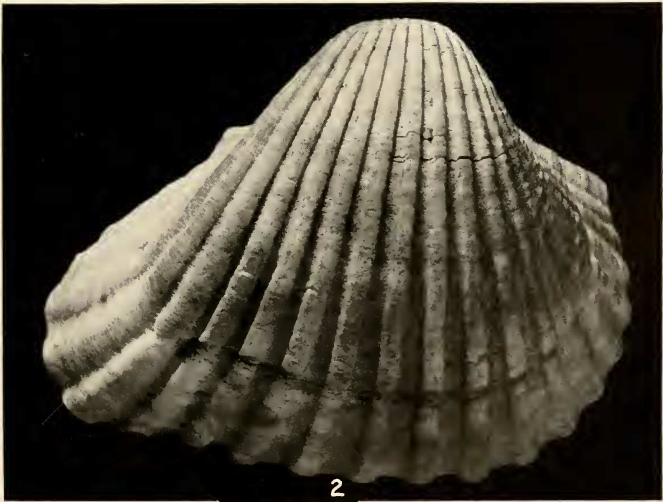
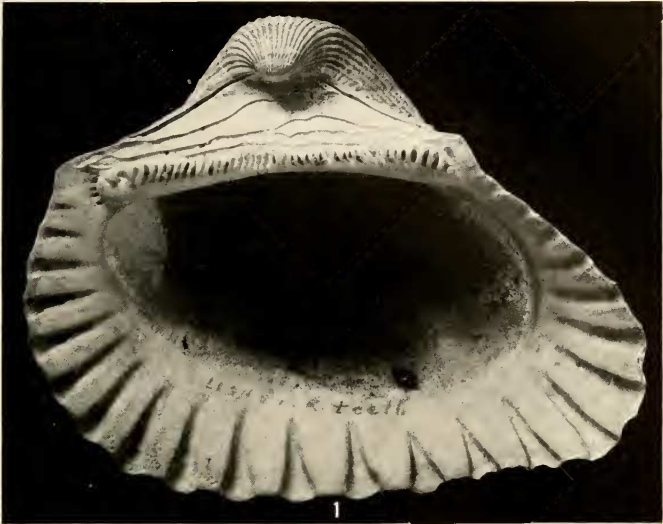


PLATE 19

- Figs. 1, 2. *Cardium* (*Trachycardium*) *pueblense* Anderson, new species. Holotype No. 4660 (C. A. S. type coll.), left side and front views; Loc. 267, C. A. S., horizon R, Tuberá group, Tuberá village; p. 164.
- Fig. 3. *Pecten atlanticola* Anderson, new species. Holotype No. 4661 (C. A. S. type coll.), right valve; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain, Department of Atlántico; p. 156.
- Fig. 4. *Pecten macloskeyi* Anderson, new species. Holotype No. 4662 (C. A. S. type coll.), right valve; Loc. 267, C. A. S., horizon P, Tuberá group, north slope of Tuberá mountain; p. 157.
- Fig. 5. *Pecten macloskeyi* Anderson, new species. Paratype No. 4663 (C. A. S. type coll.), left valve of small shell; Loc. as above; p. 157.
- Fig. 6. *Arca* (*Anadara*) *usiacurii* Anderson. Holotype No. 4158 (C. A. S. type coll.), interior of left valve; Loc. 306, C. A. S., horizon P, Tuberá group, near Usiacuri village; p. 148.
- Fig. 7. *Pecten atlanticola* Anderson, new species. Paratype No. 4661a (C. A. S. type coll.), left valve; Loc. 267, C. A. S., horizon P, as above; p. 156.

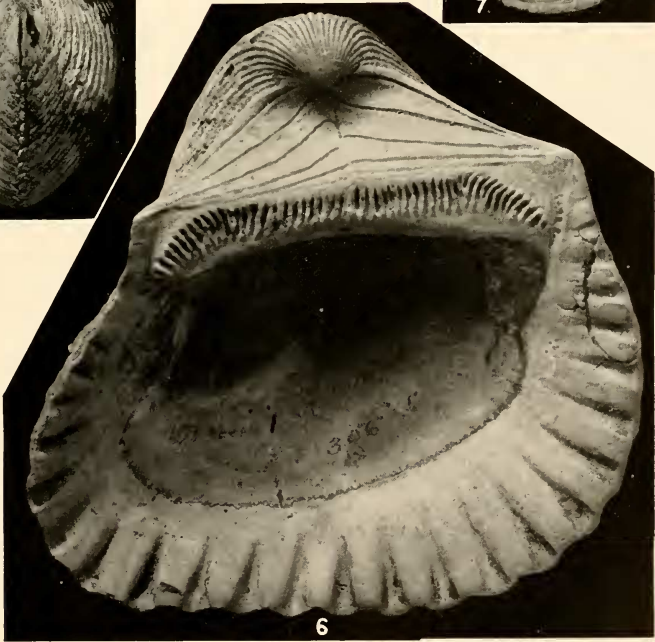
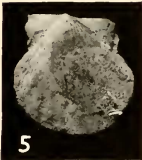


PLATE 20

- Figs. 1, 2. *Mastra* (*Mulinia*?) *atlanticola* Anderson, new species. Holotype No. 4161 (C. A. S. type coll.), side and anterior views; Loc. 267, C. A. S., horizon, M - N, Tuberá group, west foot of Tuberá mountain; p. 175.
- Fig. 3. *Mastra* (*Mulinia*?) *atlanticola* Anderson. Paratype No. 4162 (C. A. S. type coll.), interior view, showing hinge parts in right valve; Loc. 267, C. A. S., horizon P, as above; p. 175.
- Figs. 4, 5. *Cardita* (*Carditamera*) *arata* (Conrad). Plesiotype No. 4164 (C. A. S. type coll.), exterior and interior views of left valve; Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 160.
- Fig. 6. *Arca* (*Anadara*) *usiacurii* Anderson. Holotype No. 4158 (C. A. S. type coll.), exterior of left valve; Loc. 306, C. A. S., horizon P, Tuberá group, near village of Usiacuri; p. 148.



PLATE 21

- Fig. 1. *Thyasira bisecta* (?) (Conrad). Plesiotype No. 4664 (C. A. S. type coll.), cast, left valve; Loc. 350, C. A. S., near Arboletes Bay upper beds of the Tuberá group; p. 162.
- Figs. 2, 3. *Tellina protolyra* Anderson, new species. Holotype No. 4163 (C. A. S. type coll.), side and top views; Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 174.
- Fig. 4. *Arca* (*Anadara*) *usiacurii* Anderson. Paratype No. 4159 (C. A. S. type coll.), interior of left valve, showing crowding of cardinal teeth; Loc. 267, C. A. S., upper part of horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 148.
- Fig. 5. *Mactrella* (*Harvella*) *elegans* (Sowerby). Plesiotype No. 4665 (C. A. S. type coll.), Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 176.
- Fig. 6. *Mactrella* (*Harvella*) *elegans* (Sowerby). Plesiotype No. 4666 (C. A. S. type coll.), Loc. 267, C. A. S., as above, showing hinge left valve; p. 176.

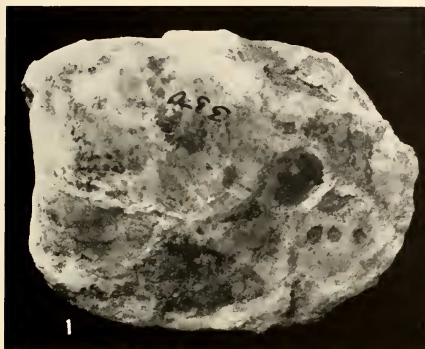


PLATE 22

- Figs. 1, 2. *Chama scheibei* Anderson, new species. Holotype, No. 4667 (C. A. S. type coll.), exterior of left and right valves; Loc. 267, C. A. S., horizon M - N, Tuberá group, west foot of Tuberá mountain; p. 161.
- Figs. 3, 4. *Glycymeris usiacurii* Anderson, new species. Holotype No. 4668 (C. A. S. type coll.), external and internal views of left valve; Loc. 325, C. A. S., horizon P, Tuberá group, east of Usiacuri village; p. 153.
- Figs. 5, 6. *Diplodonta woodringi* Anderson, new species. Holotype No. 4669 (C. A. S. type coll.), side and top views; Loc. 325-A, C. A. S., horizon P, Tuberá group, near Cibarco; p. 162.
- Figs. 7, 8. *Glycymeris lamyi* Dall. Plesiotype No. 4670 (C. A. S. type coll.), external and internal views; Loc. 325-A, C. A. S., horizon P, Tuberá group, near Cibarco, Colombia; p. 152.
- Fig. 9. *Erycina turbacoensis* Anderson, new species. Holotype No. 4671 (C. A. S. type coll.), Loc. 305, C. A. S., horizon P, Tuberá group, near Turbaco, 13 miles east of Cartagena; p. 163.
- Fig. 10. *Erycina turbacoensis* Anderson, new species. Paratype No. 4672 (C. A. S. type coll.), Loc. 305, C. A. S., as above; p. 163.

